CLINICAL STUDY AND PATCH TESTING IN CONTACT DERMATITIS DUE TO METALS

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CERTIFICATE

Certified that this dissertation entitled '**CLINICAL STUDY AND PATCH TESTING IN CONTACT DERMATITIS DUE TO METALS'** is a bonafide work done by **Dr.N.ROKINI**, Post Graduate Student of the Department of Dermatology, Venereology and Leprosy, Madras Medical College, Chennai – 600003, during the academic year 2009 – 2012. This work has not previously formed the basis for the award of any degree.

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DECLARATION

I, **Dr.N.ROKINI,** solemnly declare that dissertation titled, "**CLINICAL STUDY AND PATCH TESTING IN CONTACT DERMATITIS DUE TO METALS"** is a bonafide work done by me at the Department of Dermatology and Leprosy, Madras Medical College, Chennai-3 during the period of October 2009 to September 2011 under the supervision of **Prof. Dr. S. JAYAKUMAR, M.D., D.D,** Professor and HOD, The Department of Dermatology and Leprosy, Madras Medical College, Chennai. The dissertation is submitted to Tamilnadu Dr. M.G.R. Medical University, towards partial fulfillment of requirement for the award of **M.D. Degree (Branch-XII A) in DERMATOLOGY, VENEREOLOGY AND LEPROSY**.

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CONTENTS

INTRODUCTION

Metals are the most frequent contact allergens and sensitivity found both in occupational and non occupational group. Contact dermatitis to metals are increasing due to the rapid growth of industrialization and due to the vast increase in occupations in the construction industry.

Most of the metals cause some form of skin reactions as allergic or irritant contact dermatitis.[1] Allergic contact dermatitis to metals occurs only if the metal salts are in solution, as occurs with perspiration or exposure with body fluids. In addition to direct skin contact with metals, dermatitis to metals can occur due to ingestion or implantation of metals. Allergic sensitivity to a metal is highly specific, but cross-sensitivity with other metals can occur. Many of the cross reactions between metals are actually co- reactions, which occur due to simultaneous exposure to two or more metals.

Co- reactions are more common among cobalt, nickel and chromium. Polysensitization, which is considered to represent susceptibility to delayed-hypersensitivity in general, is also associated with the concurrent reactions to the metals. Hence, not only coupled exposure, but also individual susceptibility may be responsible for concurrent reactions to metals in man.[2]

Lymphocyte testing for metal allergy produces non specific reactions and correlation of positive tests with clinical finding is lacking. Currently patch testing remains the “gold standard” for diagnosis.

OCCUPATIONAL DERMATOSIS

Occupational exposure to metals especially chromium, nickel, cobalt are more common. A medical definition adopted by the committee on the occupational dermatosis of the American medical association (1939) was, ‘An occupational dermatosis is a pathological condition of the skin for which occupational exposure can be shown to be a major causal or contributory factor’. An occupational dermatosis is defined as 'a skin disease that would not have occurred if the patient had not been doing the work of that occupation.[3]

Evidences in favor of an occupational origin are:

- Working in contact with an agents known to have caused similar skin changes.
- Occurrence of similar dermatosis in fellow workers or those within the same occupation.
- Correct time relationship between exposure and dermatitis.
- Type and site of lesions consistent with information of exposure.
- Attack of dermatitis appearing after exposure, followed by improvement or clearing after exposure ceases.
- History and examination corroborated by patch test results Of all the occupational dermatosis, contact dermatitis is the most common, comprising 20-90% of all the cases.[4]

Review of literature

REVIEW OF LITERATURE

CONTACT DERMATITIS

Contact Dermatitis is an inflammatory response of skin to an exogenous substance. It is classified as

- Irritant contact dermatitis
- Allergic contact dermatitis
- Photoallergic, Phototoxic dermatitis
- Non eczematous reaction

IRRITANT CONTACT DERMATITIS

It is a non immunologic local inflammatory reaction characterized by erythema and edema following single or repeated application of a substance.[5] Concentrated salt solution of nickel, chromium, cobalt can produce irritant contact dermatitis. Irritant contact dermatitis may be

- Acute irritant contact dermatitis
- Delayed irritancy
- Cumulative irritant contact dermatitis.

ALLERGIC CONTACT DERMATITIS

Allergic contact dermatitis is due to delayed type of hypersensitivity reaction or cell mediated immunity to various allergens.

HISTORY

The term “ALLERGIE” was first coined by Von Pirquet in 1906. It was derived from Greek “Allos” & “ergon” meaning other or different work.[6]Allergic sensitization of skin was first proved experimentally by Bloch & Steiner woerlich using Primula extract on humans .[7]Jadassohn who described contact allergy to mercury in 1895 is considered the “Father of contact dermatitis”.[8]

In 1927, Landsteiner published studies regarding antigen containing “Simple chemical compounds”. Landsteiner &Chase published their findings that both contact allergy to small molecular allergens & delayed type hypersensitivity to microbial antigens could be passively transferred with lymphocytes in Guinea pigs.

PATHOGENESIS:

In allergic contact dermatitis the induction of sensitivity is the primary event to occur before clinical expression.

Immunology of allergic contact dermatitis involves 2 main processes

(1) Sensitization (induction or afferent limb)

(2) Elicitation (efferent limb).[9]

SENSITISATION

The main events are

(1) Binding of allergens to skin components.

An allergen, usually a hapten comes in contact with langerhan's cell & associates with the MHC class II molecules.[10] This occurs in 6 hours.[11] This requires costimulatory factors such as IL 1β, TNFα, GM-CSF by Matzinger's danger hypothesis.[12]

(2) Recognition of complete or conjugated antigen.

The antigen presenting cell (APC) carries the antigen via lymphatics to paracortical areas were it is apposed to 'T' lymphocytes. Apposition is assisted by physical factors & cellular adhesion molecules like LFA-1 on CD4 cells with ICAM-1 on langerhans cells. This relases cytokines IL-1, IL-2.[13]

(3) Proliferation & dissemination of sensitized 'T' lymphocytes.

These cytokines leads to "Blast" formation in lymph nodes& proliferation of antigen specific CD8, CD4 cells.[14] These 'T' cells disseminate. Contact hypersensitivity is through a subset of T cells expressing CLA (cutaneous lymphocyte antigen). CLA positive lymphocytes express

CCR 10, the receptor for chemokine CCL 27 of basal keratinocytes leading to localization to the site of sensitization.[15]The cytotoxic T cells induce keratinocyte death by Fas ligand & Perforin.[16]

ELICITATION

The allergen specific T lymphocytes persist at the site of original contact for some months following sensitization, leading to 'retest' or 'flare up' reactions following re exposure at a distant site. So, on re exposure to a specific allergen in sufficient concentration, the clinical reaction develops much more quickly, usually within 24 to 48 hours, but may vary from few hours to many days. APC bind with specific T lymphocytes in epidermis leading to rapid elicitation.[17] IL-1 secreting lymphocytes may acquire HLA DR status and also present antigens.

PREDISPOSING FACTORS

INDIVIDUAL FACTORS

(1) Constitution

Capacity for sensitization varies from person to person. Fillagrin null mutation carrier status is associated with nickel allergy and self reported intolerance to ornamental jewellery.[18]

(2) Sex

Women have stronger CMI responses than men. Females are more prone to develop sensitivity to particular substances like nickel.[19]

(3) Race

Racial difference exist, but it is a reflection of exposure rather than predisposition.[20]

(4) Age

Age has a little influence. Number of positive patch test reaction tends to increase with age due to accumulation of allergies acquired over life time.[21] Nickel is the most common sensitizer in almost all studies pertaining to paediatric studies.[22] According to An Goossens et al, the most important allergens observed in children are metals, topical medications and cosmetics. Ear piercing along with atopy have been regarded as major risk factors for the development of nickel sensitization especially in girls.[23]

(5) Medication

Prednisolone more than 15 mg /day & potent topical steroids suppress allergic reactions.[24]

(6) Local factors

Preexisting irritant dermatitis affects barrier function of skin & increases absorption. Ni, Cr, Co sensitivity are

increased with hand eczema.[25] Longer the duration of eczema greater is the sensitivity.

(7) Atopic diathesis

Atopics with dry skin are more prone to contact dermatitis. Rystedt in his study concluded that persistent eczema is often found in atopic dermatitis patients. In 1985, Neilson et al studied the association of atopy, wet & dry occupation and domestic works as a risk factor for hand eczema. Atopic dermatitis increased the chances of developing hand eczema by 3 fold. Atopy doubles the effect of irritant exposure. Also atopic workers developing hand eczema have a poorer prognosis than non atopics, as they have persistent dermatitis even if they change their jobs.[26]

II- ENVIRONMENTAL FACTORS

(1) Climate

By virtue of varying UV exposure, heat, relative humidity liability to contact dermatitis varies. Friction, pressure, perspiration predisposes to nickel dermatitis.[27] Photo contact allergies are common in summer.

(2) Socioeconomic factors

Socioeconomic factors also play a role in allergic contact dermatitis. Pattern of jewellery and cosmetic usage varies according to the social class of the individuals.

(3) Cultural factors.

Safety pins made up of stainless steel contains nickel in its composition. Safety pins have ubiquitous usage across India and all the safety pins used by the participants in the study of Sharma AD et al showed positive result with dimethylglyoxime test.[28] This should be a major cause of worry for its potential impact on most women across India. In the era of modernization the practice of tattooing & body piercing has increased the risk of contact with potent allergens like nickel.[29]

III-CHEMICAL

Most allergens and haptens are electrophilic atoms (positively charged & electron deficient) which interact with nucleophilic atoms by covalent bondings to form a hapten protein complex (complete antigen). Most metals Ni2+, Cr3+, Co2+, Hg2+ are haptens.[30]

The risk of sensitization depends not only on the amount of allergen applied but also to the duration of exposure, frequency of exposure, and to the condition of skin such as preexisting dermatitis. Those with contact allergies are more susceptible to become sensitized to other allergens.

CLINICAL EXAMINATION

Eczematous responses

Eczemas may be acute, sub acute, chronic. The distribution of dermatitis may suggest a cause, for example that due to nickel. Depending on the distribution the patterns are

(1)Primary patterns

Anatomical patterns give a clue to the specific cause. Some allergens will be limited to the site of contact while others may spread to other sites by fingers.

(2)Secondary patterns

Contact dermatitis may not be localized to the primary site. Seconday patterns may be due contamination of the allergen or due to an 'id like' spread. In the later, local aggrevation may precede secondary spread by several days.

Systemically reactivated contact dermatitis

Ingestion or other systemic exposure to a contact allergen in an already sensitized individual may result in a number of different patterns of skin eruptions like focal flare of previous dermatitis or patch test site, widespread eczemas, urticarial features, vasculitis etc. Involvement of

the body folds, eyelids, buttocks induced by oral challenge with nickel in allergic patients leads to the ‘baboon syndrome’.[31]

PHOTOALLERGIC CONTACT DERMATITIS

Certain substances are transformed into photosensitizers after irradiation with UV or short wave visible radiation. Upon absorption of photons by the antigen, photoactivation to an excited state is produced. The photoactivated molecules are transformed to new substances which acts as irritants or haptens.[32]

INVESTIGATIONS

HISTOPATHOLOGY

Biopsies play a little role in contact dermatitis. Spongiosis is most marked in irritant contact dermatitis along with epidermal necrosis, acantholysis and pustulation. In Allergic contact dermatitis early lesions of acute stage shows spongiosis. Intra epidermal vesicles are formed due to rupture of intercellular attachments. There is a superficial dermal infiltrate of lymphocytes, macrophages, and Langerhans cells around blood vessels. In the subacute stage,which is a transient phase, the vesicles tends to disappear and spongiosis decreases. Parakeratotic stratum corneum begins to form. Acanthosis starts

appearing. The chronic stage is characterized by hyperkeratosis, acanthosis, broadening of rete ridges with elongation.[33]

PATCH TESTING

The diagnosis of allergic contact dermatitis is made by patch testing and of photoallergic contact dermatitis by photopatch test. Patch testing relies on the observation that primed antigen-specific T lymphocytes will be present throughout the body. Patch test reactions properly obtained and interpreted are acceptable as 'scientific proof' of a state of allergic sensitization.

INDICATIONS [34]

1. Eczematous disorders where contact allergy is suspected or is to be excluded.
2. Eczematous disorders failing to respond to treatment as expected.
3. Chronic hand and foot eczema.
4. Persistent or intermittent eczema of the face, eyelids, ears and perineum.
5. Varicose eczema.

METHODS

The basis of testing is to elicit an immune response by challenging already sensitized persons to the defined amounts of

allergen and assessing the degree of response. The amount of allergen is defined by its concentration in the vehicle and the amount applied. Chambers or discs are used to ensure occluded contact with the skin. The fixing tape should be non-occlusive, non-allergenic and non-irritant. Patch testing should not be carried out in patients with active eczema because it may reduce the threshold of activity and cause non-specific reactions. The patches should not be exposed to the sun or other sources of UV light.[35] Corticosteroids and other immunosuppressive drugs should be stopped before patch testing as they may reduce or extinguish the positive patch tests in sensitized subjects.

The commonest system used to apply allergens is the Finn chamber on a scanpor tape. The chambers consist of small occlusive aluminium discs, mounted on a non occlusive tape.

PATCH TEST DOSE

If petrolatum is used as the vehicle with disposable syringes as the containers, a length of 5 mm of test substance in vehicle is applied. For a Finn chamber, 20 mg of allergen in petrolatum dispersion has been shown to be the optimum dose.[36] If the vehicle is a fluid, digital pipette should be used to deliver 15 µl to a filter paper in the chamber. With TRUE test, the patches are pre-prepared. The risk of patch test

sensitization increases with the concentration and amount of test substance applied.

MARKING

Test sites must be marked with indelible ink or stratum corneum stains. The patient should be instructed not to bathe or shower for the duration of the tests, and to avoid exercise or other activity likely to dislodge the patches.

EXPOSURE TIME

Well-established allergens are conventionally tested in such concentrations that a 48-h exposure under an occlusive patch will generally allow penetration of an amount sufficient to provoke a reaction. An ideal regimen is a 48-h application time, with readings taken 1 h after removal and again 48 h later, that is Day 2 and Day 4,with the same observer performing the reading.[37] A single day 2 reading is not advisable as it may allow some marginal irritants to be labeled as allergens and positive reactions to more poorly absorbed allergens may be missed.[38] Immediately after removal of the patch tests, there may be erythema from the stripping action of the tape, especially in dermographic subjects, and this must be allowed to settle. Furthermore, some reactions may take up to 1 h to develop once the pressure of the strips has been released and the infiltration allowed to swell the dermis.

READINGS AND INTERPRETATION:

Recording of patch-test reactions is done according to the International Contact Dermatitis Research Group (ICDRG).[39]

-	Negative reaction.
?+	Doubtful reaction, faint erythema only.
+	Weakly (non vesicular) positive reaction. Erythema, infiltration, possibly papules
++	Strong (vesicular) positive. Erythema, infiltration, papules and vesicles.
+++	Extreme positive reaction. Intense erythema, and infiltration and coalescing vesicles. Bullous reaction.
IR	Irritant reaction.
NT	Not tested.

Patch-test results should be recorded objectively, and the interpretation of the results should be recorded separately. Once they have developed, positive allergic reactions often persist for several days. The strength of the reaction depends on barrier function, the presence or absence of sweating, the atmospheric humidity, test material, technique and the reactivity of the individual.

RELAVENCE OF PATCH TEST:

Once a decision has been reached that a patient has an allergic positive patch test, it is important to establish relevance by carefully re-

examining the patient's history, distribution of rash and materials with which there has been contact. In many cases relevance can be clearly established and avoidance advice given.

FALSE POSITIVE REACTIONS[40]

The common causes for false positive reactions are,

1. Excessive concentration
2. Impure substance (contaminants)
3. Irritant vehicle
4. Uneven dispersion
5. Current or recent dermatitis at patch-test site
6. Current dermatitis at distant sites
7. Pressure effect of hard materials
8. Adhesive tape reactions
10. 'Angry back' reaction causing intensification of weak irritants[41,42]
11. Artefact

FALSE NEGATIVE REACTIONS[43]

The common causes for false negative reactions are

1. Insufficient concentration.
2. Insufficient amount applied.
3. Failure to perform delayed readings.
4. Wet or loosened patches.

5. Failure to perform photopatch testing in a photosensitizing substance.
6. Inappropriate vehicle.
7. Substance degraded.
8. Pretreatment of patch-test site with topical corticosteroids.
9. UV irradiation of patch-test site.[44]
10. Systemic treatment with immunosuppressants.

PHOTOPATCH TESTING[45]

Photo patch testing is done to investigate patients with eczematous eruptions predominantly affecting light- exposed sites and who have worsening of lesions following sun exposure.

An UV-A source is required. Dose to be applied is 5- 10 J/cm2. Application of the allergens is performed in an identical fashion to conventional patch tests, except that they must be applied in duplicate. One set is irradiated and the other (the control) is not. The control site and the rest of the skin must be covered with an opaque material during irradiation of the photopatch-test site. The common method followed is to apply the allergens on day 0.The patches are removed; results are read on day 2. On the same day allergens on one side are irradiated. Results are again read on day 4. If the same allergen provokes an equally strong reaction on both sides, it is an indication of contact allergy alone. If it is

strongly positive on both the irradiated site and the nonirradiated site, it indicates combined contact & photocontact allergy. If the reaction is positive is only on the irrradiated site, it indicates purely photocontact allergy.

COMPLICATIONS OF PATCH TESTING

1. Active sensitisation.
2. Irritant reactions.
3. "Ectopic" flare of dermatitis.[41,42]
4. Generalized flare of dermatitis.
5. Anaphylactoid reactions.
6. Pruritus.
7. Folliculitis.
8. Pigmentary changes.
9. Scarring.
10. Edge effects.
11. Infections.

MULTIPLE PATCH TEST REACTIONS

Causes of multiple patch test reactions are

1. Non specific Hyperreactivity.
2. Multiple primary hypersensitivities.
3. Cross reactions.

Non specific Hyperreactivity

The threshold at which a false-positive irritant reaction develops differs from individual to individual and may even be variable in the same subject. During active dermatitis, uninvolved skin, even at distant body sites, exhibits increased susceptibility to irritant reactions. This 'status eczematicus' may lead to false-positive patch-test results. It has become an established tenet that 'eczema creates eczema'. When this affects adjacent patch-test sites it is often referred to as 'spillover', 'excited skin' or 'angry back'. Rietschel has proposed that 'stochastic resonance' may be involved, that is signal amplification by immune mediated events.[46]

Multiple primary Hypersensitivities[47]

Multiple primary specific (or concomitant) sensitivities to substances that are unrelated chemically are frequent among patients with contact dermatitis. Patients with a long history of dermatitis are those most likely to accumulate several primary sensitivities, because of the opportunities to encounter new allergens under conditions favourable for sensitization. Sensitization is facilitated if an allergen is applied on already injured (e.g. eczematous) skin.

Cross reactions[48]

Cross-sensitization is defined as the phenomenon where sensitization engendered by one compound (the primary allergen), extends to one or more other compounds, the secondary allergens, as a result of structural similarity. Enantiospecificity or stereospecificity may lead to cross-reactivity with some isomers and not others.

Other tests for contact allergic dermatitis

- **Open test**: Allergen applied , left to dry and read as for a standard patch test.
- **Repeat open application test (ROAT)**[49]: Allergen applied repeatedly over antecubital fossa for a fixed duration or until elicitation of positive reaction.
- **Usage test**: Suspected product is used in its usual manner for several days and the site of application observed.
- **Prophetic patch test/ repeat insult patch test**: Test agent is applied repeatedly (10-14) applications under occlusion. After a 1-week of test free period, individual is challenged with the test agent again.
- **In vitro tests**: Leukocyte migration inhibition test, Lymphocyte transformation test.

CONTACT DERMATITIS TO METALS

CHROMIUM

Chromium is a chemical element with a symbol 'Cr' & atomic number 24. It derives name from the Greek word "CHROMA" meaning colour. It is ubiquitous and the fourth most common material in earths crust. Chromium is distributed widely in both earth and sea. It is more abundant than cobalt, copper, zinc, molybdenum, lead, nickel, cadmium. It is a steel grey, lustrous hard metal that takes a high polish with a high melting point.

Chromium is a transition metal that shows several different oxidation states ranging from –II to +VI. However only the trivalent Cr(III) and hexavalent Cr(VI) oxidation states are sufficiently stable to act as haptens[50]. Hexavalent chromate in chromic acid, chromates and dichromates of potassium, sodium, and ammonium is the commonest sensitizer. The prevalence of sensitivity is commoner in men. Chromium has been of special concern to the dermatologists since 1827. William cummin in Scotland first described chrome ulcers, but there has been a special interest since Hermanni in 1901 showed that contact dermatitis could be produced by chromium. It took a furthur 24 years until Parkhurst (1925) showed by patch testing that the dermatitis was due to contact allergy. Toxic effects of chromium have been incriminated in

nasl ulceration, bronchitis, and carcinogenesis particularly of the lung. The main source of hexavalent chromium is cement. There by the 3 major sources of chromate exposure are

(1) Construction materials including cement, concrete, bricks, drywall etc.[51]

(2) Leather.[52]

(3) Metal works using chromium.

ROLE OF CHROMATES IN INDUSTRIAL DERMATITIS

- Construction works: Allergic cement dermatitis is usually due to dichromates found in cement and is highest amongst workers handling wet cement. Plaster-like mixtures used in building repairs contain chromates.
- Metal workers and welders of chromium steel alloys.
- Primer paints containing zinc chromate.
- In the automobile industry: chromate dip to prevent corrosion of nuts and bolts is a cause of chromate sensitization. In the diesel locomotive radiator fluids, chromates are used to prevent rust of radiators and pipelines.
- Workers exposed to green pigments: Dyemakers, colour makers, paint makersand painters.
- Photofilm developers.

- Workers using Engraving solutions.
- Pulp and paper industry workers.
- Artificial flower makers.
- Pottery workers.
- Woodworkers.
- Workers in explosive manufacturing.

ROLE OF CHROMATES IN CONSUMER ARTICLES

- Chrome-plated materials. Nickel acts as the offending agent after leaching of chrome layer.
- Chrome-tanned leather goods including shoes, gloves and other wearable items and accessories.
- Cosmetics containing chromate-containing pigment (green colours).
- Disinfecting and bleaching agents where chromates are used for colour and stabilizing properties.
- Safety matches, chromates commonly found in unlit and charred match heads.
- Green felt fabric used to cover snooker and card tables, chromates used in fabric dye.
- Tattoos containing chromate-containing pigment (green colours).

- Internal exposure from dental or orthopaedic implants that contain chromates.

CLINICAL MANIFESTATION

Chrome ulcers

Hexavalent chromium is ulcerogenic. Chromates have a corrosive, necrotizing effect on living tissue forming ulcers or chrome holes.[53] Chrome ulcers on skin & perforation of nasal septum can occur in workers exposed to chrome dust & solution in tanning, electroplating industries.[54] Typical chrome ulcer is a crusted, painless, punched out ulcer with undermined, indurated border. Samitz et al recommended 10% ascorbic acid in an ointment can be applied to nasal septum for prevention of chrome ulcer and prompt washing with antichrome solution of sodium pyrosulfite after contact.[55]

Irritant contact dermatitis:

Chrome in cement can produce irritant contact dermatitis from its alkaline, hygroscopic & abrasive properties.

Allergic contact dermatitis:

Allergic eruptions are insidious, persistent & prone to relapse. Although the eruption may at times be acute with oozing, it has a greater tendency to be dry, to fissure and to lichenify.[56] In occupational exposure both allergic & irritant dermatitis are common, but in general

population allergic contact dermatitis is exclusively seen. Chromate eruptions may mimic nummular eczema, atopic dermatitis, neurodermatitis, dry forms of dermatophytosis and primary irritant reactions. Chromate allergy in cement exposed individual develops following years of chronic low grade exposure.[57] Chromates in cement may cause an Air borne contact dermatitis.[58]

Hand eczema

In sensitized individuals aside from cement, dermatitis of hands can occur from the contact of leather gloves, matches, antirust compounds, yellow green paints, and certain glues. Chromate ingestion can produce pompholyx like eruptions & flares of chromate dermatitis in sensitive individuals.[59] Once acquired chromate dermatitis of hands tends to be chronic.

Chronicity of chromate dermatitis

Once chromate sensitivity is established they become more severe, more extensive & take longer to clear with each exposure, even after prompt removal from the chemical.[60] Burry & Kirk labeled chromate sensitized industrial workers "CHROME CRIPPLES".[61] Systemic exposure to chromium by ingestion is a cause for chronicity in chrome sensitive individuals.[62] Chromium occurs in highest concentration in food like thyme (10mg/g), blackpepper(3.3mg/g),

cloves(1.50mg/g). Minute quantities are found in dairy products, meat and fish.[63]

Photosensitive eczemas

There is an increased photosensitivity in chromium dermatitis. There are reports of seasonal variation in with a peak in late summer.[64] Photosensitivity reactions to chromate & cobalt have been reported by Tronnier et al.[65]

Cement dermatitis and chromates

The main sensitizers in cement are dichromates, but other metals like Nickel and Cobalt may be present. Soluble Chromates have been found in most of 25 samples of British cement.

The patterns of cement contact dermatitis [66]are

1. Dryness irritation.
2. Acute irritant contact dermatitis (cement burns).
3. Chronic (cumulative irritant) contact dermatitis.
4. Allergic contact dermatitis.

Not only construction workers, but also Artists and do it yourself home builders are at risk of hazards of cement dermatitis.[51] Changing work to avoid contact with cement does not seem to improve the prognosis.[67,68] Many Chromate sensitized cement workers develop

hardening. Ferrous sulfate has been added to cement manufactured in Denmark, since September 1981.

Addition of ferrous sulphate to fresh cement reduces the water soluble hexavalent chromate to trivalent chromate making it less allergenic.[69] Denmark passed legislation requiring the use of cement with lower levels of hexavalent chromium in 1983; Finland followed at the beginning of 1987 and Sweden in 1989. A statistically significant decrease in the number of workers with allergic cement eczema was found in the cohort exposed to cement with the lower water soluble chromate concentration.[70]

Patch testing for chromium

Sensitivity is demonstrated by a closed patch test with potassium dichromate 0.5% in petroleum.

Chromium spot test (Diphenyl carbazide test)[71]

It is a qualitative test to detect hexavalent chromium. The object is placed in water to extract chromium and a few drops of concentrated sulfuric acid and 0.5% diphenyl carbazide in ethanol are added to the object. A red –violet colour develops if the object contains Chromium. This test is sensitive to 10 parts per million of chromate.

NICKEL

Nickel is a chemical element with the symbol Ni, and atomic number 28. It is a silvery white lustrous metal with a slight golden tinge. It has a slow range of oxidation at room temperature and is corrosion resistant. It is widely used as alloys with copper, aluminium, lead, silver and gold. Through out the world, nickel is reported to be one of the most common causes of allergic contact dermatitis particularly in women.[72,73] "Nickel is with you and does things for you from the time you get up in the morning until you go to sleep at night." This phrase from the brochure "*The Romance of Nickel*" clearly shows that this metal is present in a large variety of products, and therefore is almost impossible to avoid.[74,75]

Ear piercing at an early age seems to increase the risk of incurring Ni sensitivity.[29] In men Ni dermatitis has been deemed to be predominantly of occupational origin. Nickel solutions can pass through rubber gloves.

Industrial exposure to nickel[76] occurs in

- Metal refining industries from the ore,
- Nickel plating industries,
- Workers of ceramic, dyeing industries, printing industries,

- Hairdressers[permanent wave solutions of ammonium thioglycolate leach nickel from scissors]
- Retail clerks,
- Printing industries,
- Food service workers, cleaners [involving wet works].

In women nickel dermatitis occurs both occupationally and non occupationally. Women are commonly exposed to nickel in ornamental jewellery."Hypoallergenic" solid gold (12 carat or more) and silver jewellery are safe. Nine carat gold and white gold both contain nickel.

The composition of some alloys[77] are

*Chromel alloy : Ni 90% & Cr 10%

*Nichrome alloy: Ni 80% &Cr 20%.

From 2001, the European Union Nickel Directive has limited nickel in items intended for direct and prolonged contact with skin, such as jewellery, watches, buttons, spectacle frames, etc. The limit value for nickel release is 0.5 mg/cm^2/week. The nickel content in piercing posts has to be below 0.05%.[78] Denmark has banned the sale of any jewellery or clothing accessory that releases more than 0.5 mg/cm^2/week of nickel since 1990.[79] Nickel was voted " The Allergen of the year 2008" by the American contact dermatitis society. According to Schmidt et al

nickel triggers an inflammatory response by directly activating Human TLR4.[80]

The common nickel containing foods are green beans, broccoli, canned vegetables, canned fruit, dried fruit, nuts, cocoa, and chocolate.[81]

Clinical pattern of Nickel dermatitis

The dermatitis are classified into 2 groups

(1)Primary or Localized

In affected individuals, dermatitis develops in places where nickel- containing metals are in direct contact with the skin. The most common sites are the earlobes (from ear rings), the wrists (from a watch strap) and the lower abdomen (from a jeans stud). Bracelets, bangles, metallic spectacle frames, safety pins, etc can also cause contact dermatitis.[82] This contact may present as acute dermatitis or become dry, thickened and pigmented (chronic dermatitis). The lesions may occasionally be papular. Nummular eczemas are also frequently associated.

(2) Secondary

These eruptions behave like an autosensitive haematogenous spread similar to id phenomenon. Involvement of the previously exposed sites and patch test sites occurs (flare up

dermatitis). It can also present as pompholyx type of eruption, Flexural eczema, Baboon syndrome, Erythema muliforme type of eruption, urticaria, or Prurigo.[83]

The patterns of hand eczema's in nickel sensitive patients are

(1) Localized dermatitis due to direct contact.[84]

According to Suman et al, one of the commonest allergens in hand eczemas of Indian patients were nickel (20%) and chromium (20%).[85]

(2)Pompholyx or dishydrosiform dermatitis

Pompholyx can occur due to ingestion of nickel containing foods.[83] Unfortunately, it is not possible to avoid ingesting nickel as it is present in most of the foodstuffs. The concept of ingested nickel as a cause of hand eczema is supported by the clinical improvement brought about by the chelating agent disulfiram.[86]

Patch testing for Nickel

According to Cronin et al Ni sulfate 5% in a vehicle of aquaeus solution has an even distribution of nickel salt. Other antigenic composition are nickel sulfate 2.5% in DMSA, nickel chloride.[87]

Nickel Spot test (Dimethyl glyoxime test)

This test has been modified & popularized by Fisher.[88] The kit contains

- 1% Dimethyl glyoxime in ethanol solution
- 10% Ammonium hydroxide solution.

A few drops of each are successively applied to a cotton tipped applicator, which is rubbed against a metal object. Dimethylglyoxime reacts with nickel ions in the presence of ammonia, giving a strawberry red colour in the cotton. A worn area of the surface should be checked, especially in chrome-plated objects, to avoid a false negative test.

If the spot test is negative, other tests, such as atomic absorption spectrometry or the calorimetric method, may be performed to detect nickel.

COBALT

Cobalt is a chemical element with symbol Co & atomic number 27. It is a shiny grey brittle, magnetic metal widely used in additives to produce a blue colour in porcelain, glass potteries, & enamel. In earth it is found along with nickel and copper.[89]

Occupational cobalt dermatitis occurs in

- Industries using hard metal.
- Paint industries.
- Cement industries.[90]
- Carbide industries.
- Polyester resin manufacturing.
- Pottery workers.
- Manufacturing of alloys containing cobalt.

Clinical manifestation

As cobalt is invariable contaminant of nickel, the pattern of cobalt allergy can be identical to those of nickel allergy. Presence of cobalt in cement may induce a clinical pattern identical to allergy from chromate. Certain plastics may release cobalt salts and induce contact sensitivity. Isolated cobalt allergy in hard metal workers, pottery and glass industries are associated with hand dermatitis. Dental plates and fillings may release sufficient cobalt to produce stomatitis or vesicular hand eczema in sensitive patients. Rarely a widespread, disseminated or nummular eruption may occur.[91]

Photosensitization dermatitis due to Cobalt

Romageura et al found few patients with chronic photocontact dermatitis were sensitive to Cobalt Salts. Photooxidation tests proved that Co salts are photosensitizing.[92]

Patch testing

Testing is done with Cobalt chloride – hexahydrate 1% aquous by Indian Standard series.

PREVENTION OF CONTACT DERMATITIS

Principles of prevention can be related to two categories, individual and collective, and further divided into primary, secondary and tertiary. Primary prevention focuses on the induction of contact sensitization and control of exposure. Secondary prevention relates to elicitation, and tertiary to measures for established and continuing dermatitis. Protective measures, work practice, and physician education should be improved to prevent or manage such problems.[93] The various steps that can be taken for prevention of contact dermatitis are

1. Allergen containment and replacement.
2. Legal and regulatory measures.
3. Corporate responsibility.
4. Domestic precautions and hygiene.
5. Barrier method for preventing contact.
6. Wear protective clothing and employ no-touch techniques.
7. Proper education.

Protective measures for occupational chromate exposure

8. Addition of other chemicals (e.g. iron sulphate[94] or combination of barium hydrate, nitrate and chloride with lead acetate) to cement or mortar to neutralize the chromate content.

9. Application of a barrier cream made from ascorbic acid (vitamin C) and EDTA (a chemical which binds metals).

10. Impregnation of ascorbic acid into filters of respirators enhances protection against inhalation of chromate dust, particularly useful in chromate-sensitive printing and lithography workers.

11. Using disposable hand towels by workers in the chromate industry to avoid cross contamination.

12. To thoroughly wash all clothing contaminated with chromates.

13. Wearing thick absorbent socks and using other nonchromate chemicals for tanning and curing leather can minimize this form of exposure.[95,96]

Prevention of nickel contact dermatitis

14. Sterile stainless needles should be used for piercing. After piercing wear only nickel-free earrings for at least the first three weeks.

15. Substitute products made of materials that do not cause reactions.[97]

TREATMENT

I Avoidence advice

The first principle of management is to give advice on avoidance tailored to an individual. Examples of specific avoidance measures include clothing free of nickel-containing studs, zips, etc. It is advisable to stress that allergy does not disappear when the dermatitis clears but that the risk of relapse after further contact with the allergen persists throughout life.

II Active treatment:

The mainstay of treatment of allergic contact dermatitis is avoidance of the causative factors, although topical corticosteroids will be required in most instances.

1. For acute weeping dermatitis, wet dressings with saline soaks, aluminium acetate, or Silver nitrate can be given.
2. Emollients and soap substitutes to be used.
3. Secondary infection is treated with Antibiotics.
4. Antihistamines for pruritus.
5. Topical Tacrolimus and Pimecrolimus can be given.

6. In severe widespread eruptions , systemic steroids may be necessary.[98]
7. Recalcitrant disabling cases may require immunosuppressive therapy such as Azathioprine and Cyclosporine.

PROGNOSIS

Prognosis of allergic contact dermatitis depends on its cause and feasibility of avoiding repeated and continued exposure of the causative allergen. The prognosis is poor for those allergic to Nickel and Chromium as a result of their ubiquity in the environment. According to the results of a follow-up questionnaire of the study by Dooms-Goossens A et al, more than 70% of the patients allergic to chromates or nickel continued to suffer from contact eczema after the diagnosis had been made and therapeutic measures taken.[99]Once acquired this contact sensitivity tends to persist.[100]

Chronicity of contact dermatitis is attributed to the following factors,

1. Impaired barrier function of the skin.
2. In appropriate treatment.
3. Ingestion of allergens.
4. Secondary infection.
5. Autosensitisation.
6. Stress.
7. Constitutional factors.
8. Inherent tendency of eczemas to become chronic.
9. Atopy.

Aim of the study

AIMS OF THE STUDY

1. To study the incidence of sensitization to metals like chromium, nickel, and cobalt among patients with a presumptive diagnosis of contact dermatitis to metal antigens.
2. To study the age and sex incidence among patients of contact dermatitis to metals antigens.
3. To study the association of contact dermatitis to metal antigens with atopy.
4. To find the incidence of occupational and nonoccupational causes of metal contact dermatitis.
5. To study the association between the duration of exposure to metal antigens required for clinical manifestation in the occupational group.
6. To study the various combinations of presentations among chromium, nickel and cobalt and to compare the results with the literature.

STUDY DESIGN

Prospective, observational study.

Materials and methods

SAMPLE

277 cases of contact dermatitis with a history of exposure to metals attending the OPD of occupational contact dermatitis section, department of dermatology, Rajiv Gandhi Government General Hospital (RGGGH), Chennai from October 2009 to October 2010 were included in the study. The study was approved by the institutional ethical committee, RGGGH & Madras medical college, chennai. A written consent form was signed by all.

METHODS

A detailed history of the patients including the age, sex, chief complaints, the type of occupation and the duration of exposure to metals in their occupation were noted. Based on the morphology and distribution of the lesions patients were diagnosed as allergic contact dermatitis, irritant contact dermatitis and photocontact dermatitis. Clinical pattern's of the distribution of the contact dermatitis was noted. History, symptoms and signs suggestive of atopy, past history of similar illness and any drug intake both prior and after the onset of lesions were noted**.** Patients with history and clinical features compatible with contact dermatitis due to metals were patch tested

Procedure: PATCH TESTING was done for all the patients with the three metal antigens available in the Indian standard series.

- 0.1% Potassium dichromate.
- 5 % Nickel sulphate.
- 5 % Cobalt sulphate.

Patch testing was deferred in patients with

*Active disease (Acute Eczema)

*on Systemic Steroids

*on Antimetabolites.

Inclusion Criteria: All the patients of allergic contact dermatitis and photoallergic contact dermatitis with positive patch test results and all patients of irritant contact dermatitis with irritant reaction were included for analysis.

Exclusion Criteria: Patients with contact dermatitis and who patch tested negative for the metals antigens.

STATISTICAL ANALYSIS:

Analysis was done using the SPSS software. Whereever required Pearsons chi square was used to calculate the P value. Two by two tables were evaluated by Fisher's exact two tailed test.

PROCEDURE OF PATCH TESTING:

The patch test allergens used were from the Indian Standard Series approved by the Contact and Occupational Dermatoses Forum of India (CODFI).

Patch testing was done as follows,

1. The protective foil of the finn chambers was removed and the patch test unit was placed on the table with the aluminium chambers facing up.
2. 5mm length of the allergens from the syringe was put in the centre of the aluminium chambers.
3. Aqueous allergens (nickel and cobalt) were applied using a filter paper disc.
4. The upper back of the patient was gently cleaned with sterile gauze before application of antigens.
5. Allergens were applied on the patch test unit with the first allergens in the top right hand corner and then downwards in the region of upper back.
6. The control was applied on the left side of upper back in parallel to the allergens on the right side.
7. Patches were removed after 48 hours (2 days).

8. Reading was taken after 1 hour.

9. A second reading was taken on day 4.

INSTRUCTIONS GIVEN TO THE PATIENTS

Following instructions were given to the patients

1. Patch test to be left in place for two days and two nights.

2. Not to take bath or wash the back during the period.

3. To avoid tight garments.

4. To avoid exercise or any other activity causing sweating.

5. To avoid friction or rubbing and lying on back.

6. To avoid scratching the patch test site.

7. To avoid exposure to sunlight/ UV light.

8. To report immediately if there is any severe itching or irritation.

9. To come for patch test reading after 48 and 96 hours.

The readings on both sides were compared. The readings were then interpreted according to the guidelines devised by the International Contact Dermatitis Research Group (ICDRG).

Observations and results

OBSERVATION

A total of 277 patients with a history of an exposure to metal antigens were recruited for the study. Based on the history and clinical morphology, they were diagnosed as allergic contact dermatitis, irritant contact dermatitis and photo allergic contact dermatitis. All cases were patch tested with three metal antigens: chromium, nickel and cobalt. Patients with history of exposure to other allergens were patch tested with appropriate antigens from the Indian standard series.

237 patients with positive patch test reaction to the metal antigens were included for analysis. 40 patients who tested negative to all three metals antigens were excluded from the analysis.

TABLE 1 – CLINICAL DIAGNOSIS

Diagnosis	Frequency	Percent
Allergic contact dermatitis	210	88.6
Irritant contact dermatitis	16	6.8
Photo allergic contact dermatitis	11	4.6
Total	237	100.0

Out of the 237 patients analysed, 210(88.6%) had allergic contact dermatitis, 16 patients had irritant contact dermatitis and 11 had photoallergic dermatitis. In our study, allergic contact dermatitis constituted the majority of metal contact dermatitis.

TABLE 2- SEX DISTRIBUTION

Gender	Frequency	Percent
Male	130	54.9
Female	107	45.1
Total	237	100.0

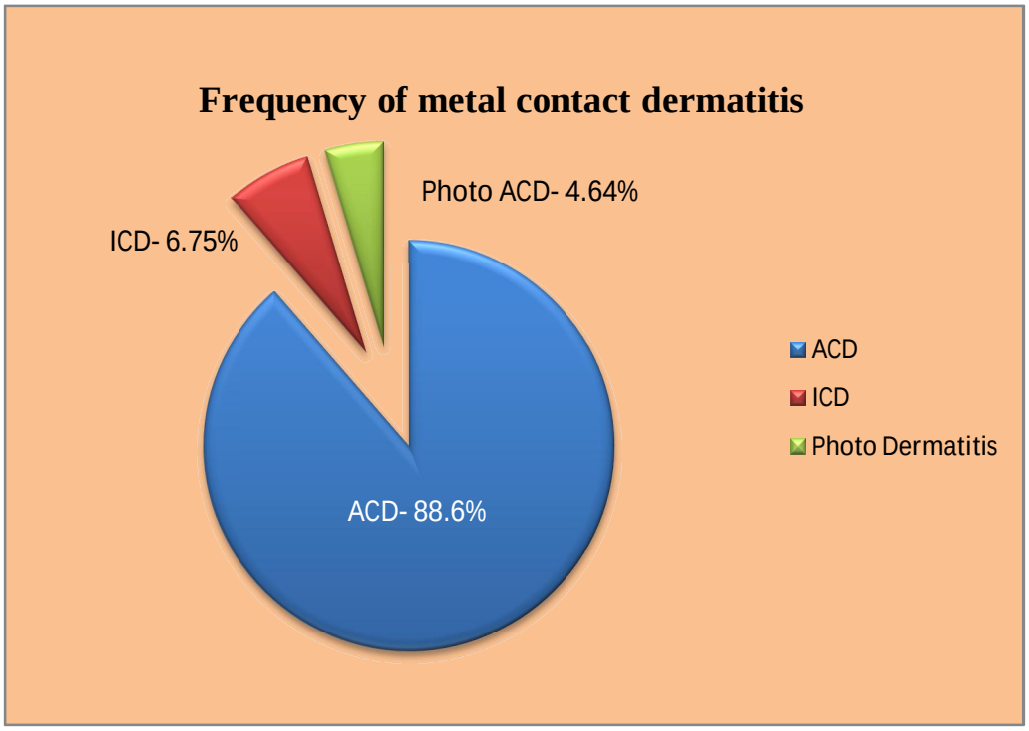
Out of the 237 patients analysed, 130(54.9%) were males and 107(45.1%) were females.

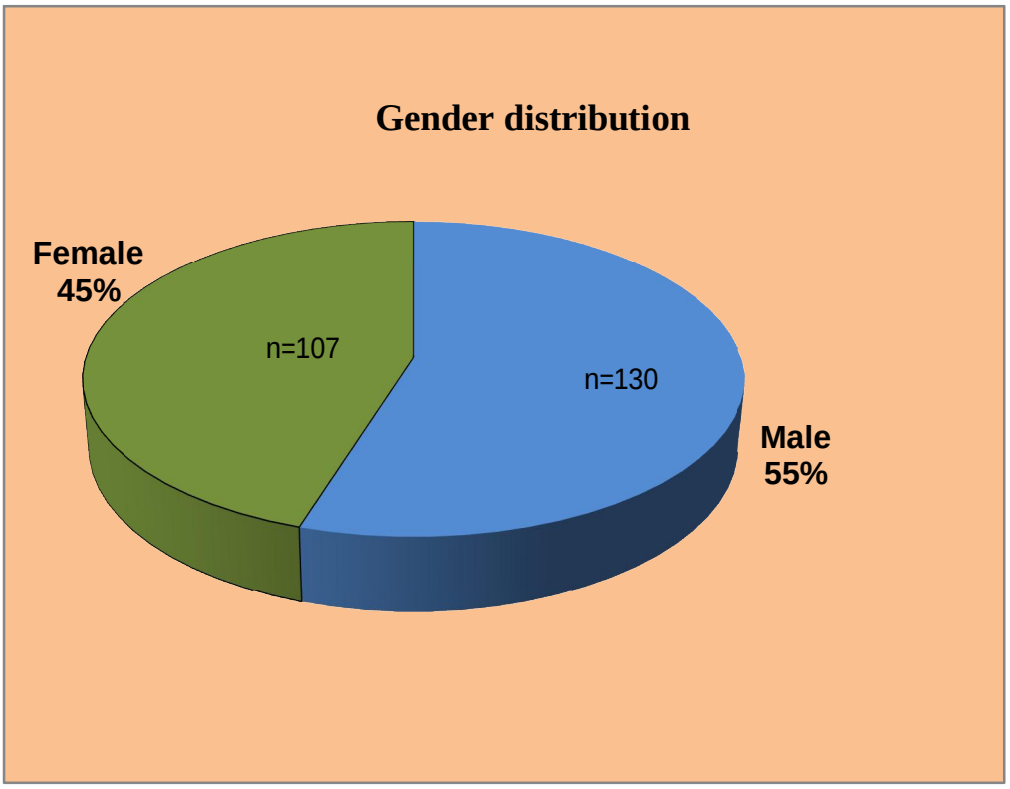
TABLE 3- AGE AND SEX DISTRIBUTION

Age Group	SEX		Total		P-Value
	Male	Female	No:	%	
<= 20 yrs	3	7	10	4.2	0.563
21 - 30 yrs	32	27	59	24.9	
31 - 40 yrs	34	29	63	26.6	
41 - 50 yrs	33	24	57	24.1	
> 50 yrs	28	20	48	20.3	
Total	130	107	237	100.0	

X^2 (Chi square test of independence)=2.971

Majority of the patients (179 cases) were in the age group of 21-50 years. They formed 75.6% of the total. The youngest patient in the study was an18 month's old female child and the oldest was a female aged 77 years.


Frequency of metal contact dermatitis
Photo ACD- 4.64%
ICD- 6.75%
ACD- 88.6%
ACD
ICD
Photo Dermatitis


Gender distribution
Female
45%
n=107
n=130
Male
55%

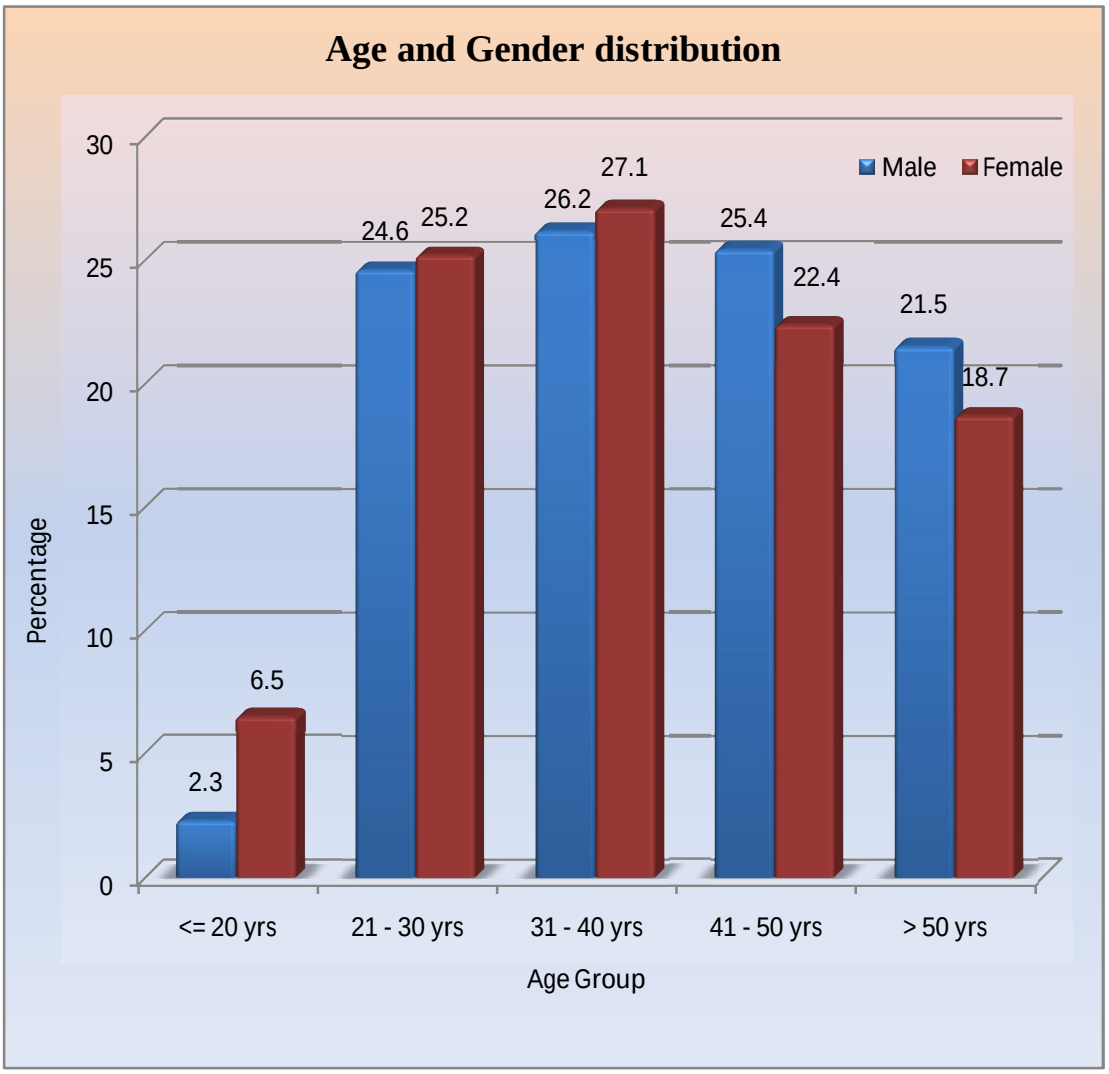

Age and Gender distribution
Male
Female
Percentage
30
25
20
15
10
5
0
2.3
6.5
24.6
25.2
26.2
27.1
25.4
22.4
21.5
18.7
<= 20 yrs
21 - 30 yrs
31 - 40 yrs
41 - 50 yrs
> 50 yrs
Age Group

TABLE 4 – DISTRIBUTION BY TYPE OF EXPOSURE

Exposure	Number of patients	Percentage
Occupational	149	62.86%
Non occupational	88	37.13%

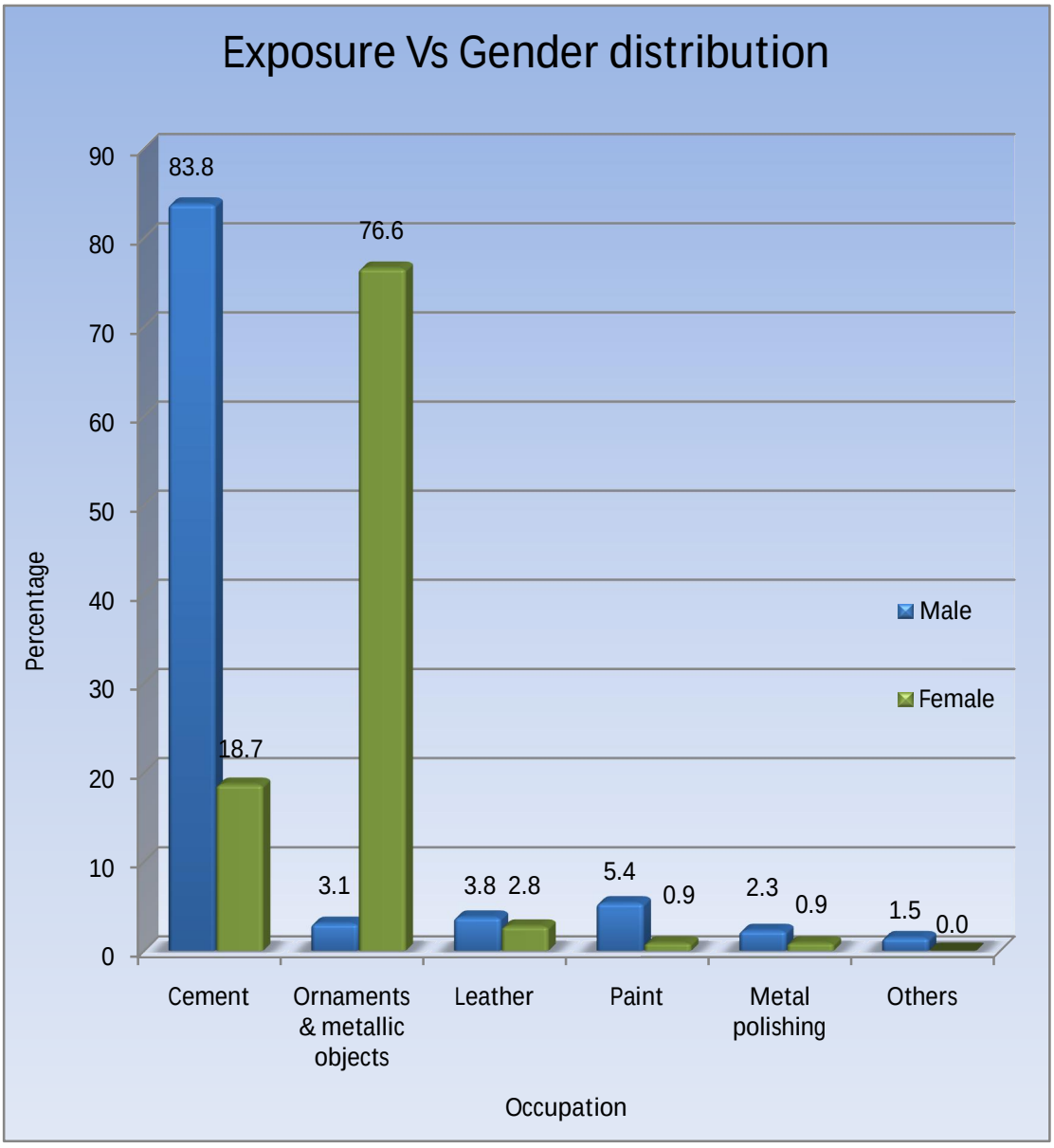
Among the 237 cases of metal contact dermatitis, exposure in 149 cases (62.86%) was occupational, forming the majority. The ratio of occupational to nonoccupational exposure was 1.69:1.

Based on the source of exposure, the patients were grouped as having cement exposure, ornaments & other metallic objects exposure, leather, paint, metal polish exposure and others.

TABLE 4.1- EXPOSURE vs GENDER DISTRIBUTION

Occupation	Male		Female		Total		P-Value
	No:	%	No:	%	No:	%	
Cement	109	83.8	20	18.7	129	54.4	<0.001
Ornaments & metals Objects	4	3.1	82	76.6	86	36.3	
Leather	5	3.8	3	2.8	8	3.4	
Paint	7	5.4	1	.9	8	3.4	
Metal polishing	3	2.3	1	.9	4	1.7	
Others	2	1.5	0	.0	2	.8	
Total	130	100.0	107	100.0	237	100.0	

X^2 (Chi square test of independence)=139.23


Exposure Vs Gender distribution
Percentage
90
80
70
60
50
40
30
20
10
0
83.8
18.7
3.1
76.6
3.8
2.8
5.4
0.9
2.3
0.9
1.5
0.0
Male
Female
Cement
Ornaments & metallic objects
Leather
Paint
Metal polishing
Others
Occupation

In our study, cement topped the list as the source of metal exposure with 129 patients (54.4%), followed by ornaments & metallic objects exposure with 86 patients (36.3%). One mechanic and one worker in glue packaging who had metal exposure were the least in the study and they were grouped in the category 'Others'. Among the 129 patients in the cement exposure group, males were the majority (109 patients) constituting 84.4%.Out of the 86 patients in the ornaments & metallic objects exposure group, females constituted 95.35%. This association was statistically significant (P value- <0.001). This may be due to fact that males were more commonly employed in the construction industry and females have the passion of wearing ornaments more.

TABLE 5- INCIDENCE OF ATOPY

Atopy	Number of patients
Present	47
Absent	190

Of the 237 cases 47 cases (19.8%) were atopic individuals by Hanifin and Rajka criteria.

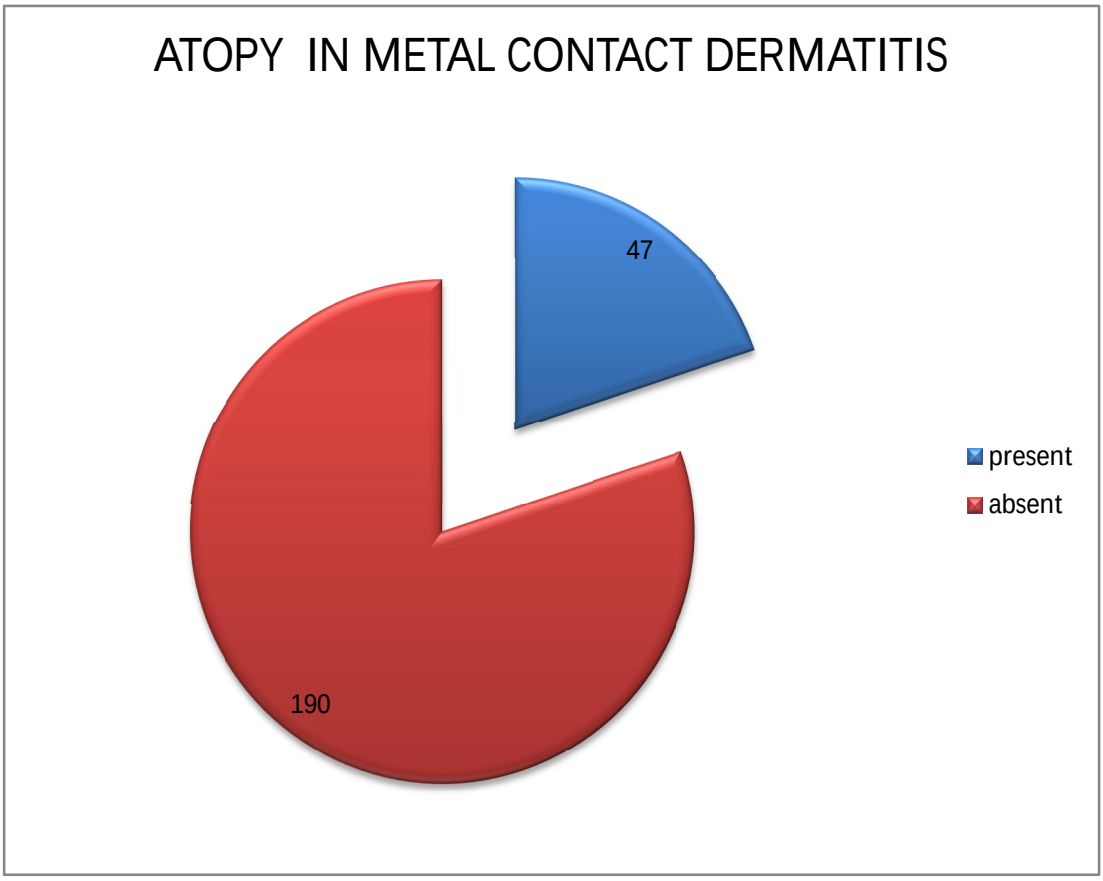

ATOPY IN METAL CONTACT DERMATITIS
47
190
present
absent

TABLE 5.1 ASSOCIATION OF ATOPY WITH PATCH TEST RESULTS

Patch test	Atopy Present		Atopy Absent		Total		P– Value
Positive	47	88.7%	190	84.8%	237	85.6.%	0.6636
Negative	6	11.3%	34	15.2%	40	14.4%	
Total	53	100%	224	100%	277	100.0%	

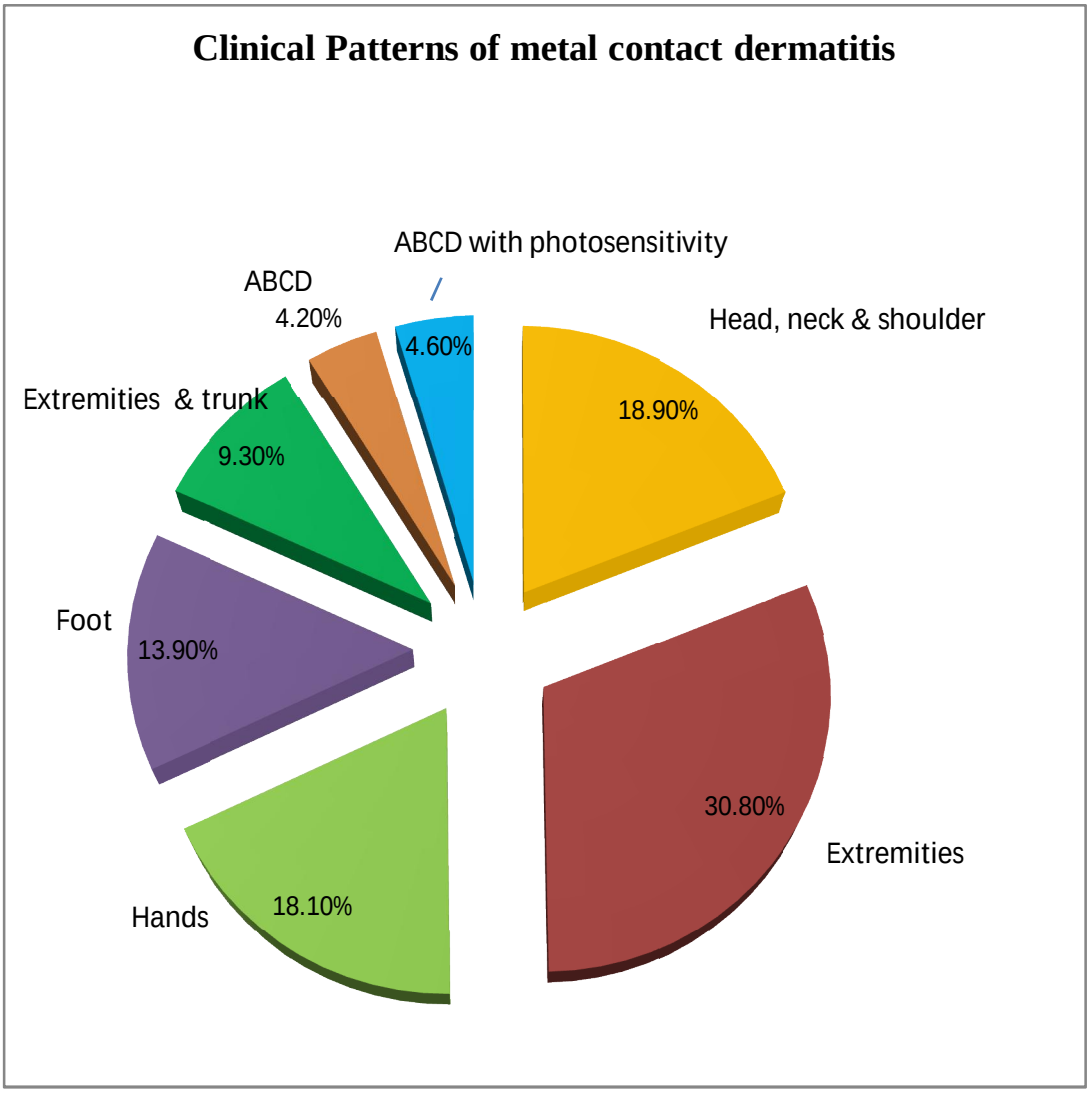
P value calculated by Fisher's exact test

Among the atopics 88.7% had positive patch test where as among the nonatopics, 84.8% had positive patch test. The P value was 0.6636 and the association of atopy with patch test positivity was not statistically significant. Thus atopy did not significantly influence the propensity for developing metal sensitivity.

TABLE 6- CLINICAL PATTERN OF METAL CONTACT DERMATITIS

Clinical Pattern	Frequency	Percent
Localized to extremities(UL, LL or both)	73	30.80%
Localized to Head, neck & shoulder	45	18.98%
Localized to hand only	43	18.14%
Localized to foot only	33	13.92%
Localized to trunk, back & extremities.	22	9.3%
ABCD with photosensitivity	11	4.64%
Air borne contact dermatitis (ABCD)	10	4.21%
Total	237	100%

UL- upperlimb, LL- lowerlimb.


Clinical Patterns of metal contact dermatitis
ABCD with photosensitivity
4.60%
ABCD
4.20%
Head, neck & shoulder
18.90%
Extremities & trunk
9.30%
Foot
13.90%
30.80%
Extremities
Hands
18.10%

Among the various clinical patterns, maximum patients (73) had metal contact dermatitis confined to the extremities, either upperlimb or lowerlimb or both. The next common clinical pattern was dermatitis localized to the head, neck and shoulder in 45 patients.

TABLE 7- PATCH TEST RESULTS

ANTIGENS	Male		Female		TOTAL		P value
	No:	%	No:	%	No:	%	
Chromium	84	64.6	27	25.2	111	46.8	
Nickel	2	1.5	27	25.2	29	12.3	
Cobalt	3	2.3	7	6.6	10	4.2	
Cr and Ni	9	6.9	19	17.8	28	11.8	<0.0001
Cr and Co	20	15.4	6	5.6	26	11.0	
Ni and Co	1	.8	13	12.1	14	5.9	
All three	11	8.5	8	7.5	19	8.0	
Total	130	100.0	107	100.0	237	100.0	

X^2 (Chi square test of independence) = 72.744

Among the three metals patch tested, chromium (46.8%) was the topmost metal to elicit positive results in isolation, followed by nickel (12.3%) while positivity to both chromium and nickel was seen in 11.8%. Out of the 237 patch test positive patients, 16 had irritant reactions.

TABLE 8- GRADING OF PATCH TESTS

GRADING	NO: of positive reactions
1+	238
2+	78
3+	11
Irritant reaction	16

343 positive reactions were found in 237 patch tested patients. Of these 238 reactions was 1+ and grading 3+ was the least in the study.

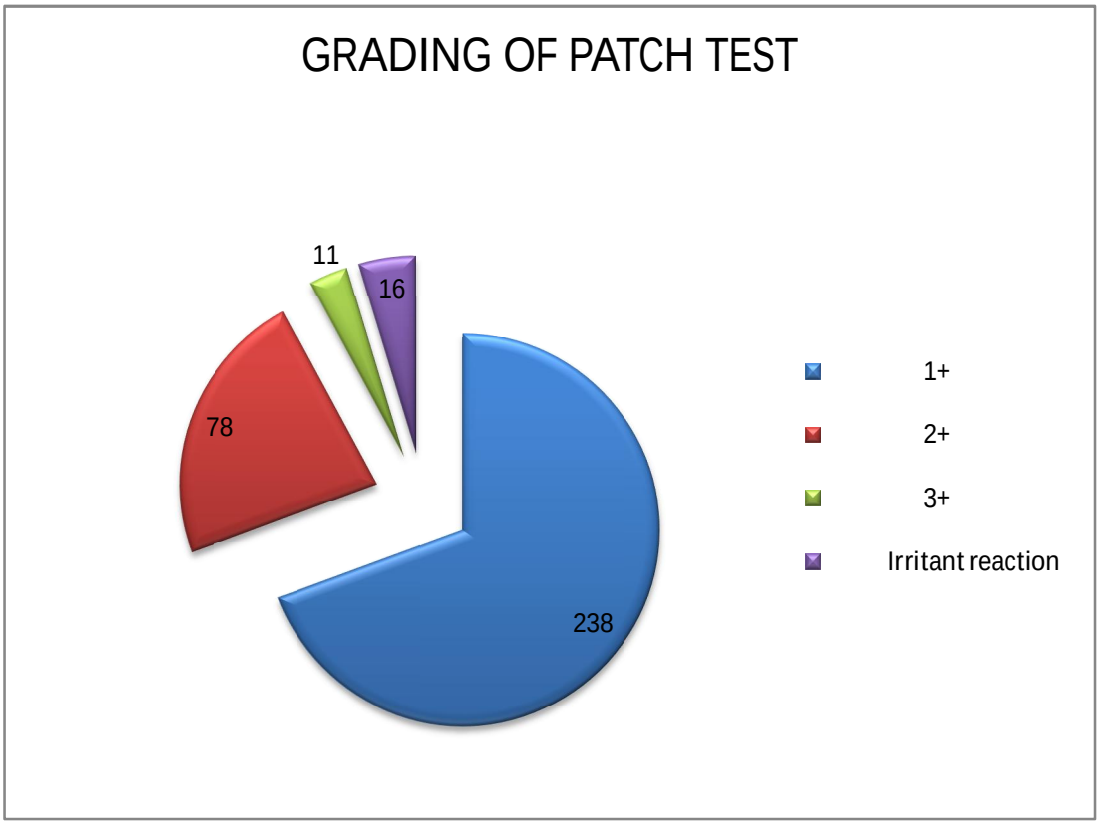
TABLE 9- INCIDENCE OF SENSITIZATION TO METALS

(In isolation or in association)

Metals	Isolated		Associated		Total	P value
	No:	%	No:	%		
Chromium	111	60.3%	73	39.6%	184	<0.001
Nickel	29	32.2%	61	67.7%	90	
Cobalt	10	14.5%	59	85.5%	69	

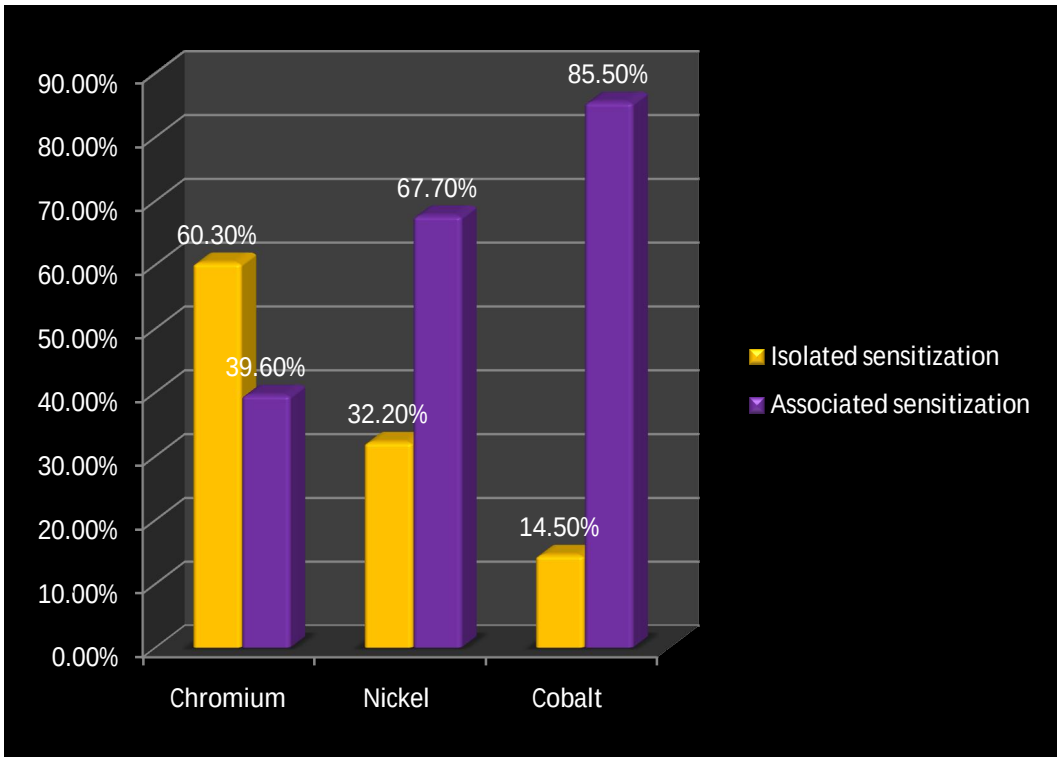
X^2 (Chi square test of independence) = 49.4

Chromium was an isolated sensitizer in 111patients (60.3%) while in 73 patients (39.6%) chromium sensitivity was associated with either nickel or cobalt sensitivity. Nickel and cobalt most commonly presented as co sensitizers. In 67.7% patients nickel and in 85.5% cobalt were associated with other metal sensitivity. This association of chromium sensitization presenting commonly in isolation, and nickel & cobalt sensitization presenting in association with other metals is statistically significant (p value <0.001).


GRADING OF PATCH TEST
11
16
78
238
1+
2+
3+
Irritant reaction

METAL SENSITIZATION

(in isolation & association)



Due to the simultaneous exposure to other antigens, 77 patients were also patch tested with other allergens from the Indian standard series.

TABLE 10– ALLERGENS ASSOCIATED WITH METAL ALLERGY

Allergens	Cement	Ornaments	Leather	Paint	Others	Total
Parthenium	10	0	0	0	0	10
Balsum of peru	2	7	0	0	0	9
Turmeric	0	6	0	0	0	6
PPD	0	6	0	0	0	6
Formaldehyde	0	2	2	0	1	5
Epoxy resin	0	0	0	1	0	1
Fragrance mix	0	2	0	0	0	2
Colophony	0	2	0	0	0	2
Epoxy + Formaldehyde	0	0	0	1	0	1
Parthenium + PPD	0	1	0	0	0	1
Total	12	26	2	2	1	43

Parthenium was the most common allergen to be associated with metal allergy found positive in 11 patients. Balsum of Peru and turmeric, PPD followed in frequency.

ALLERGENS ASSOCIATED WITH METAL ANTIGENS

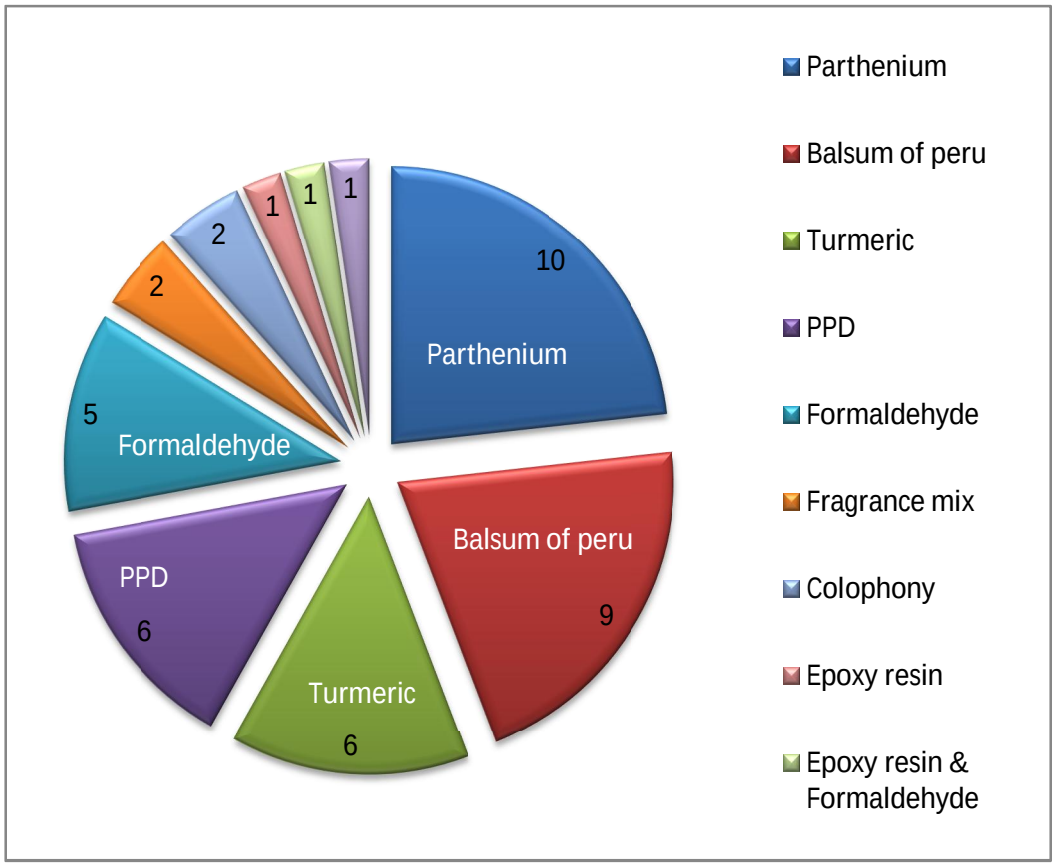


TABLE 11- PATCH TEST RESULTS to INDIVIDUAL METALS.

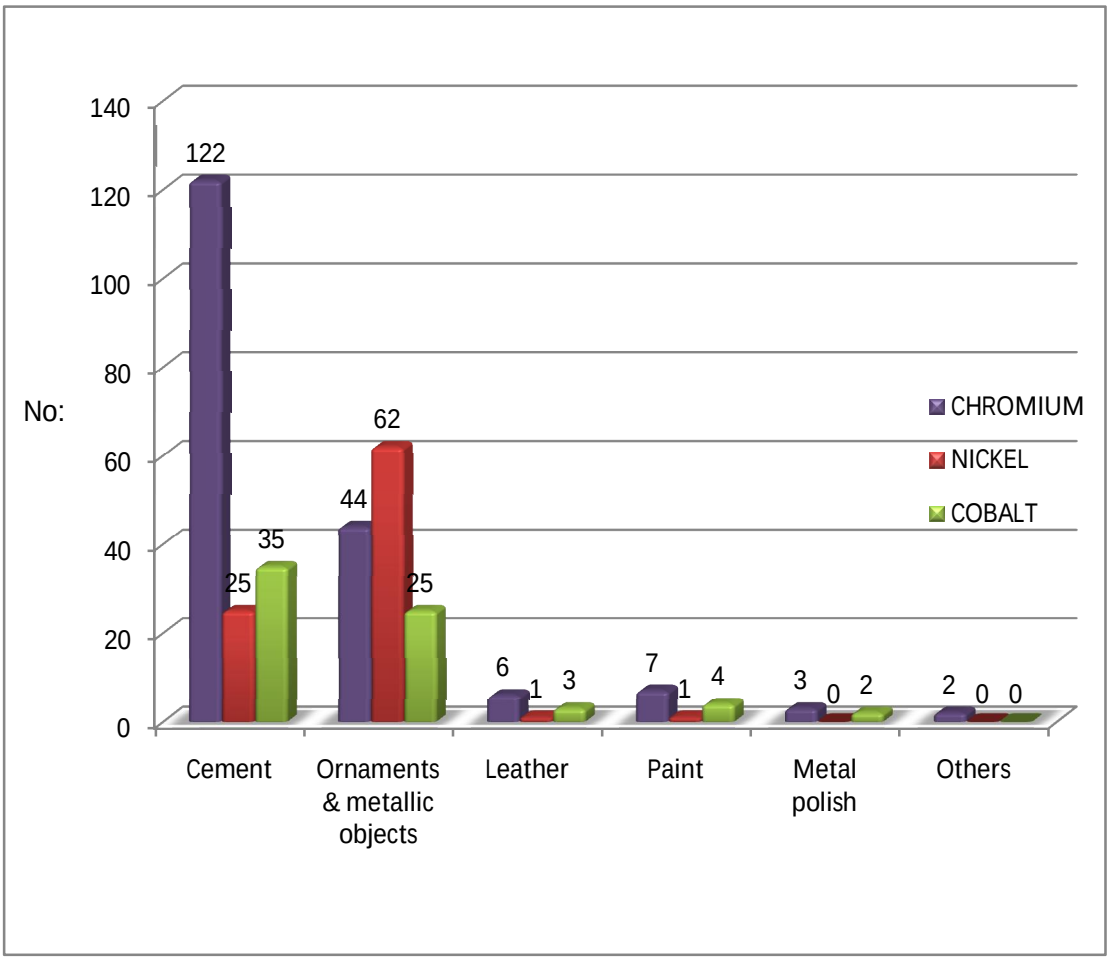
OCCUPATION	Chromium	Nickel	Cobalt	P value
Cement	122	25	35	<0.0001
Ornaments& metallic objects	44	62	25	
Leather	6	1	3	
Paint	7	1	4	
Metal polish	3	1	2	
Others	2	0	0	
Total	184	90	69	

X^2 (chi square test of independence) =55.69

Chromium sensitivity was the most common in occupations involving cement, leather, paint, and metal polish exposure. Chromium was also the most common metal to be sensitive in a mechanic and a glue packaging worker. Nickel was the most common antigen in those exposed to ornaments & metallic objects.This association of chromium in cement, leather, paint, metal polish exposure and the association of nickel in ornaments & metallic objects exposure group was statistically significant (P value- <0.001).

As cement and ornaments & metallic objects constituted the commonest source of exposure in the study, they are analysed in detail.

OCCUPATION VS SENSITIZATION TO METALS



CEMENT EXPOSURE

TABLE 12- OCCUPATION involving CEMENT EXPOSURE

OCCUPATION	MALE	FEMALE	TOTAL
Mason	67	10	77
Tile layer	10	-	10
Plumber	9	-	9
Electrician	8	-	8
Building contractors	5	-	5
Watchman	5	-	5
Mason& Farmer	4	4	8
Vendor	1	2	3
Housewife (cement exposure)	-	4	4
TOTAL	109	20	129

Males predominated in the cement exposure group. Overall in both sexes, masons topped the list with a total of 77 patients (59.7%). Tile layers (7.75%) and plumbers (6.97%) followed masons in frequency. Housewives formed the least number (4 patients) of this group. They were sensitized to cement due to the construction and repair works in their residencies.

TABLE 13– AGE DISTRIBUTION IN THE CEMENT EXPOSURE GROUP

Age Group	Cement	
	No:	%
<= 20 yrs	3	2.3
21 - 30 yrs	27	20.9
31 - 40 yrs	36	27.9
41 - 50 yrs	37	28.7
> 50 yrs	26	20.2
Total	129	100.0

More than half of the cases in the cement exposure group were between 31 to 50 years (56.6%). Only 3 (2.3%) were below the age of 20 years.

TABLE 14- DURATION OF EXPOSURE TO CEMENT

Duration	Number	Percentage
< 1 yr	12	9.3
1 - 5 yrs	45	34.9
5 - 10 yrs	28	21.7
10 - 20 yrs	23	17.8
20 - 30 yrs	10	7.8
> 30 yrs	11	8.5
Total	129	100%

Out of the 129 patients in the cement exposure group, 45 patients (44.2%) developed contact dermatitis within 5 years of cement exposure

and 8.5% after 30 years of exposure. The mean duration of exposure was 5.3 years.

TABLE 15-CLINICAL PATTERNS IN CEMENT EXPOSURE

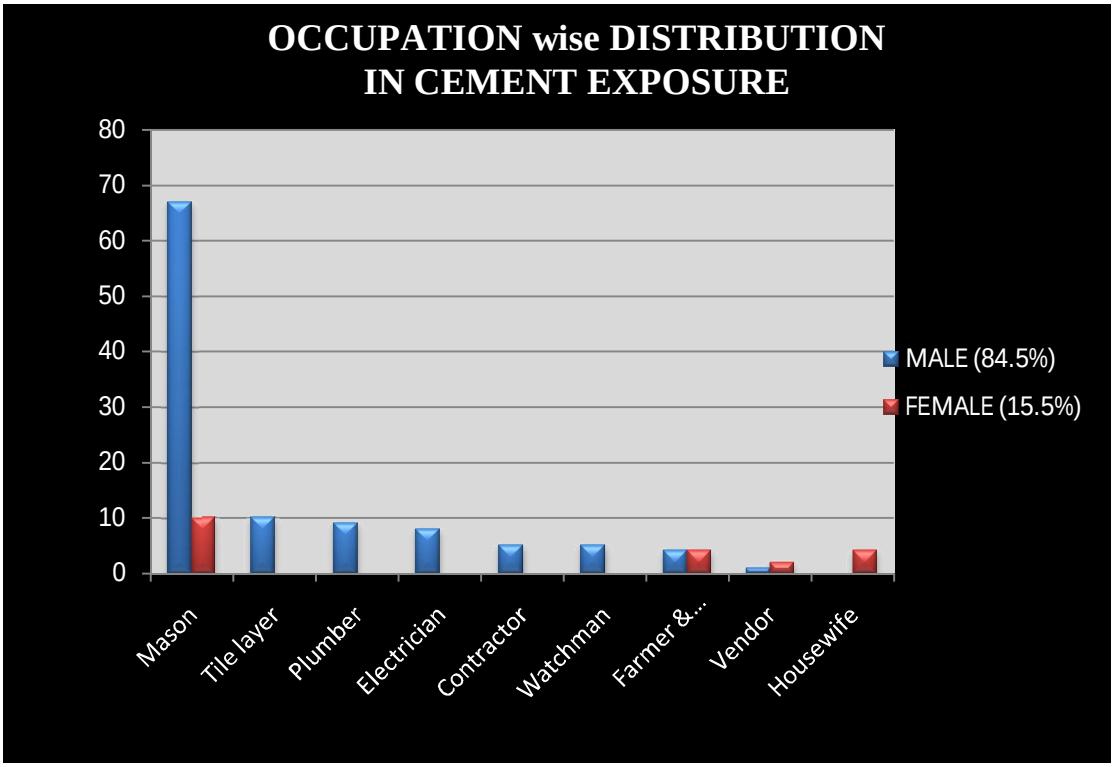
Clinical pattern	Number	%
Localized to extremities (UL , LL or both)	55	42.6
Localized to trunk, back & extremities	20	15.5
Localized to foot only	20	15.5
Localized to hand only	15	11.6
ABCD with photosensitivity	11	8.5
Air borne contact dermatitis	8	6.2
Total	129	100.0

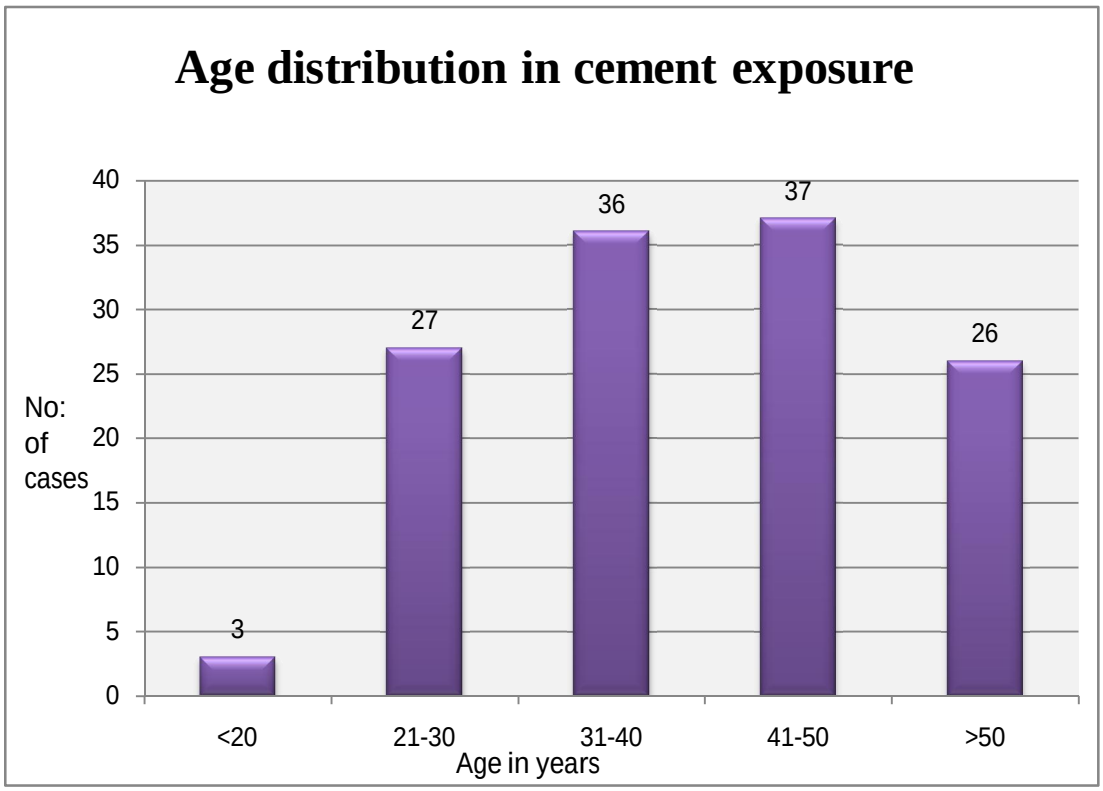
Majority of the patients (55) developed contact dermatitis localized to the extremities. This pattern of dermatitis localized to either the upperlimb or the lowerlimb or both contributed to 42.6% of the group. Foot eczema and dermatitis localized to the trunk and extremities were the next common pattern (20 each).

TABLE 16-PATCH TEST POSITIVITY IN CEMENT EXPOSURE

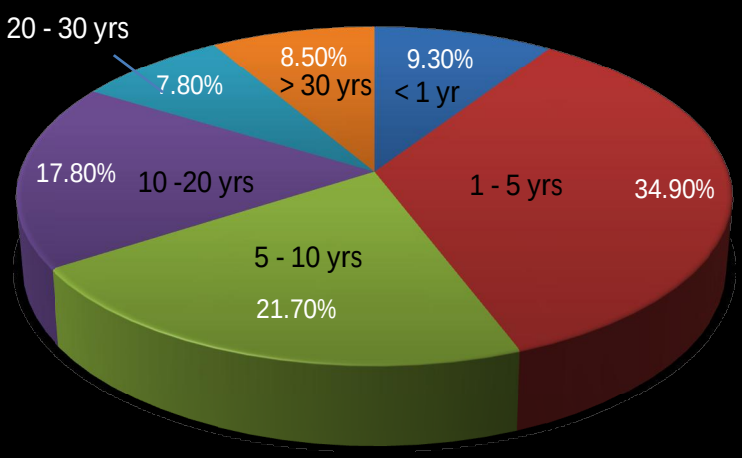
Metal antigens	Cement exposure	
	Number	**%**
Chromium	82	63.6
Cr and Co	20	15.5
Cr and Ni	10	7.8
All three	10	7.8
Ni and Co	3	2.3
Nickel	2	1.5
Cobalt	2	1.5
Total	129	100.0

Chromium was the most common metal to be positive in 122 patients (94.57%) of the cement exposure group. This sensitization was isolated in 82 patients (63.6%) and associated with other metals in 40 patients (31%). Cobalt allergy was most commonly associated with chromium presenting in 30 patients (23.25%). Among this group, 14 patients developed irritant reaction to chromium. Nickel and cobalt predominantly presented in association with other metals in the cement exposure group.

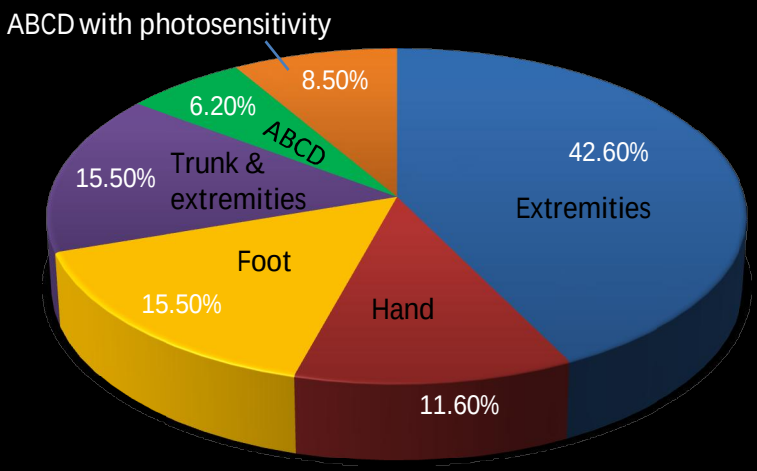

OCCUPATION wise DISTRIBUTION IN CEMENT EXPOSURE
80
70
60
50
40
30
20
10
0
Mason
Tile layer
Plumber
Electrician
Contractor
Watchman
Farmer &...
Vendor
Housewife
MALE (84.5%)
FEMALE (15.5%)

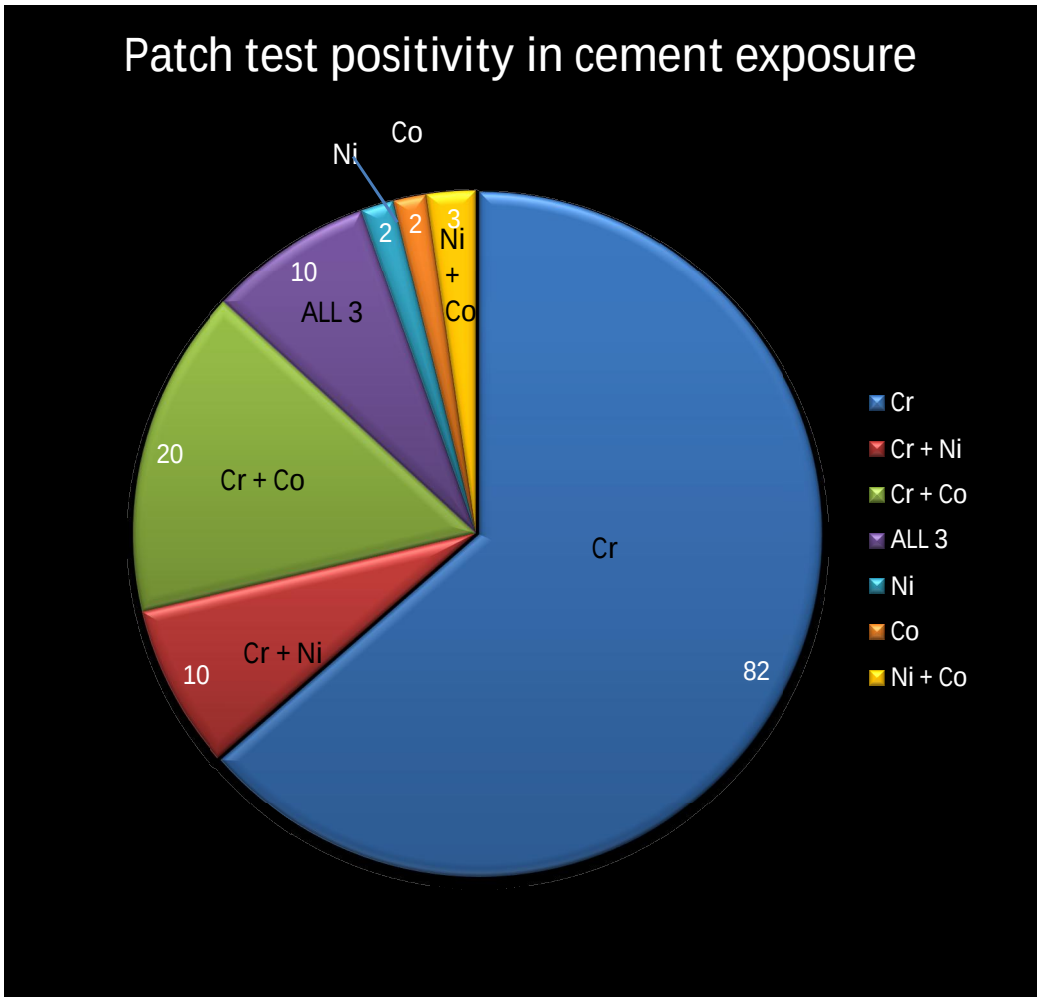

Age distribution in cement exposure
No: of cases
40
35
30
25
20
15
10
5
0
3
27
36
37
26
<20
21-30
31-40
41-50
>50
Age in years

Duration of exposure to cement



Clinical patterns in cement exposure




Patch test positivity in cement exposure
Ni
Co
2
2
3
Ni + Co
10
ALL 3
20
Cr + Co
Cr
82
Cr + Ni
10
Cr
Cr + Ni
Cr + Co
ALL 3
Ni
Co
Ni + Co

ORNAMENTS & METALLIC OBJECTS EXPOSURE

TABLE 17– OCCUPATIONS involving ORNAMENTS & METALLIC OBJECTS

OCCUPATION	MALE	FEMALE	TOTAL
House wife	-	47	47
Health worker	-	6	6
Housemaid	-	4	4
Tailor	3	5	8
Student	-	8	8
Teacher	-	5	5
Farmer	-	4	4
Weaver	-	2	2
Clerk	1	-	1
Child	-	1	1
Total	4(4.65%)	82(95.35%)	86(100%)

Among the 86 patients in the ornaments & metallic objects exposure group females formed the majority. Housewives were more commonly exposed to ornaments in our study, constituting 54.65% (47 patients) of the total. The youngest in the age group was a female child, 18 months old sensitized to nickel from a pendant and the bangles. Occupational exposure to scissors & needles was found in 8 tailors and 2 weavers.

TABLE 18-AGE DISTRIBUTION IN ORNAMENTS & METALLIC OBJECTS EXPOSURE

Age Group	Ornaments & metallic objects	
	No:	%
<= 20 yrs	6	7.0
21 - 30 yrs	24	27.9
31 - 40 yrs	22	25.6
41 - 50 yrs	16	18.6
> 50 yrs	18	20.9
Total	86	100.0

More than half of the group (60.5%) were within 40 years.

TABLE 19- PATTERNS IN ORNAMENTS & METALLIC OBJECTS EXPOSURE

Clinical pattern	Number	%
Localized to head, neck & shoulder	44	51.2
Localized to hand only	17	19.8
Localized to extremities	13	15.1
Localized to foot only	10	11.6
Air borne contact dermatitis	2	2.4
Total	86	100.0

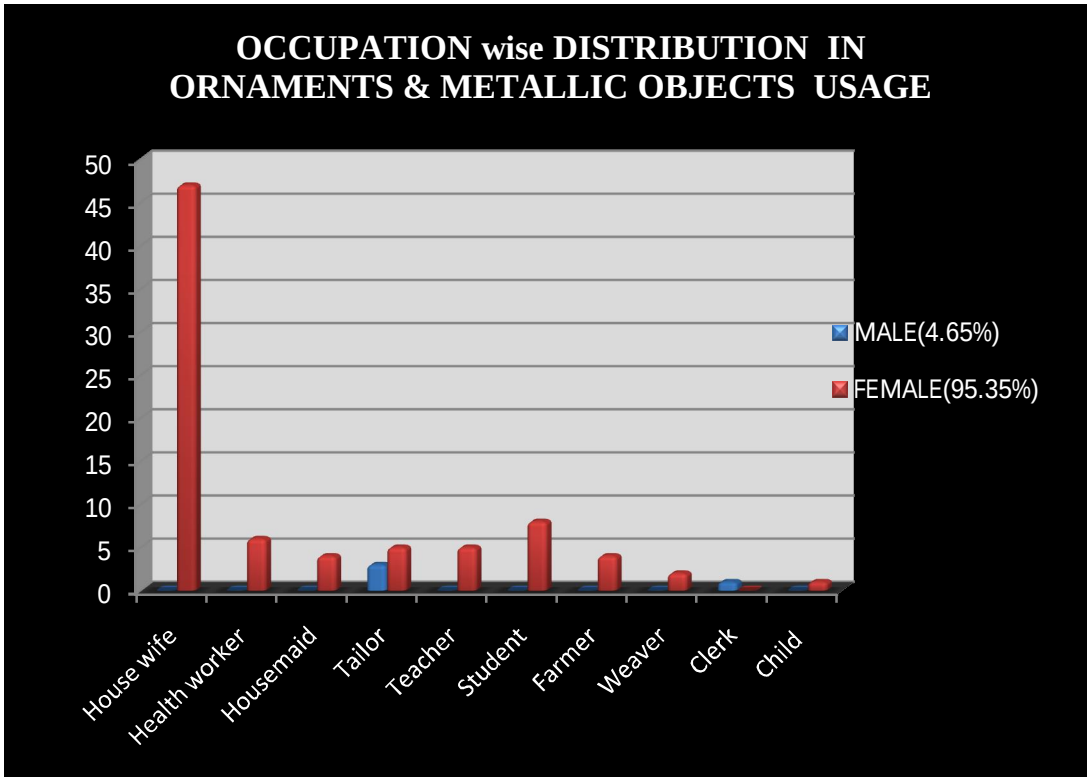
Ornaments & metallic objects exposure patients most commonly had contact dermatitis localized to head, neck and shoulder (51.2%).

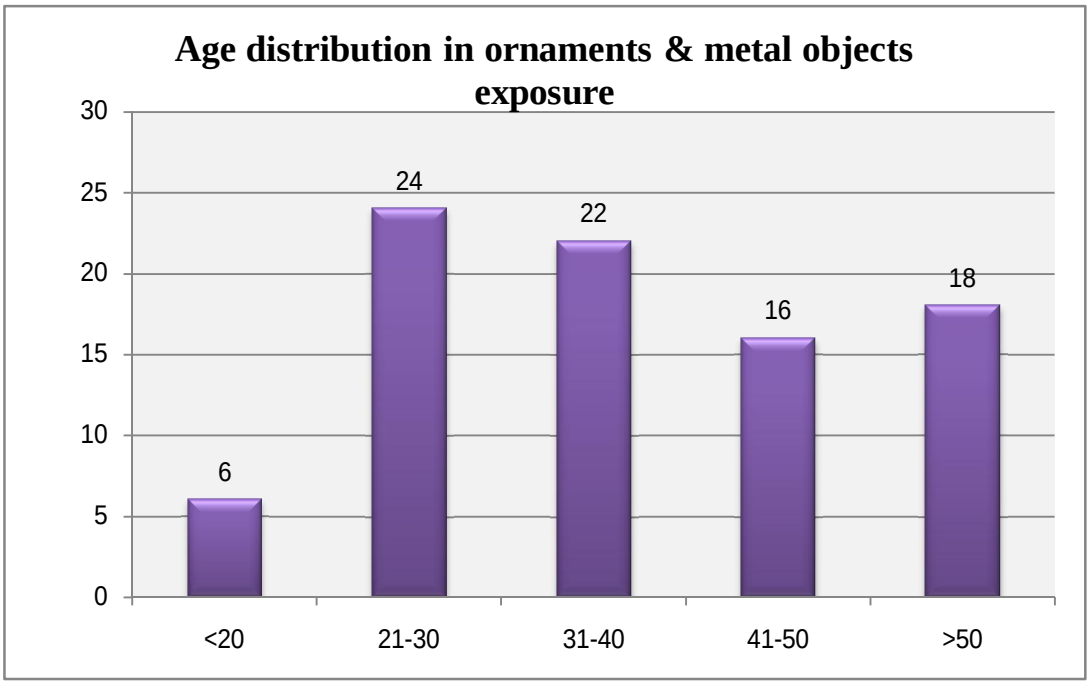
This pattern was due to exposure to ornaments in the form of earrings, chains and safetypins. The next common pattern was hand eczema in 17 patients. Two farmers, who had ABCD, were sensitive to both nickel and parthenium. Since they presented with ABCD, nickel sensitivity in them was probably of past relevance. Ten patients had dermatitis localized to the feet, of which 6 were also sensitive to detergents.

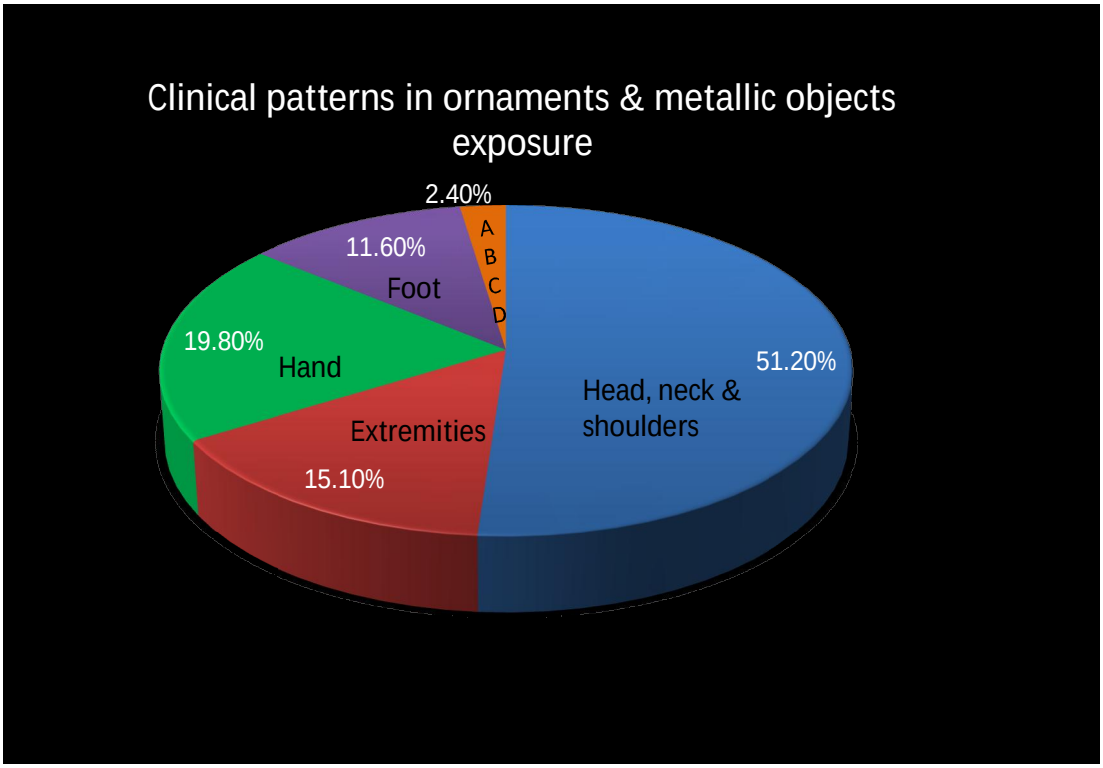
TABLE 20- PATCH TEST POSITIVITY IN ORNAMENTS & METALLIC OBJECTS EXPOSURE GROUP

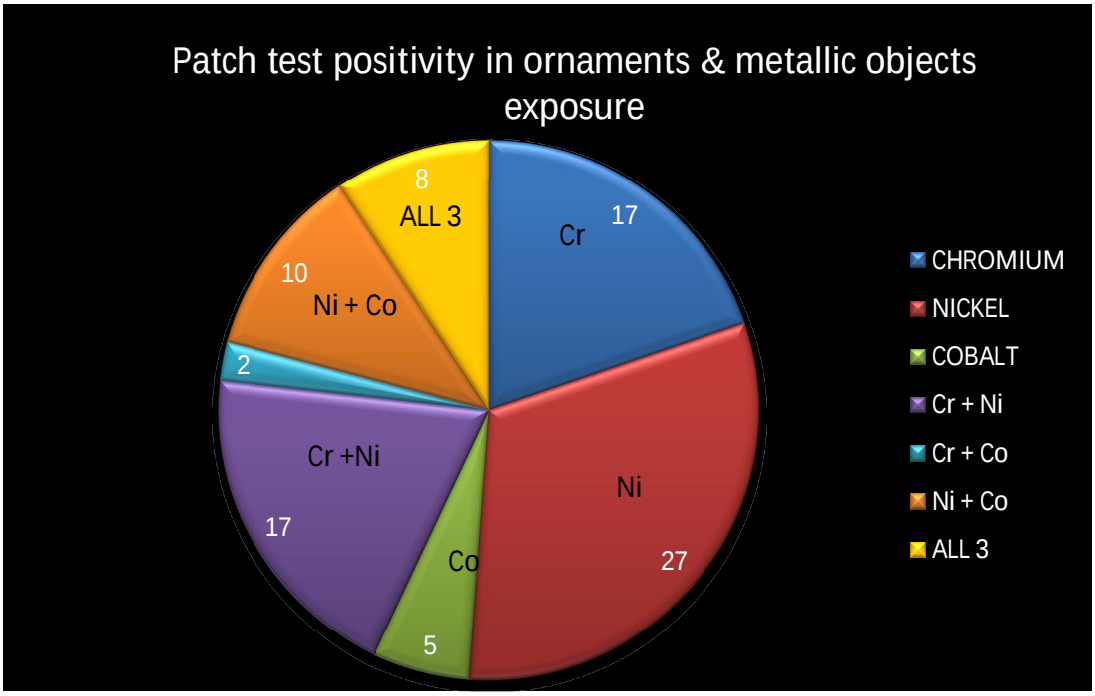
Metal antigens	Ornaments & metallic objects exposure	
Nickel	27	31.4%
Chromium	17	19.8%
Cr and Ni	17	19.8%
Ni and Co	10	11.6%
All three	8	9.3%
Cobalt	5	5.8%
Cr and Co	2	2.3%
Total	86	100.0%

Nickel was the most common metal antigen positive in 62 patients (72.1%). This sensitization was isolated in 27 patients (31.4%) and associated with other metals in 35 patients (40.7%). Chromium sensitivity in isolation and chromium sensitivity with nickel co sensitization were the next common positive presentation in frequency. Two patients with irritant contact dermatitis at the earring site showed an irritant reaction on patch testing.


OCCUPATION wise DISTRIBUTION IN ORNAMENTS & METALLIC OBJECTS USAGE
50
45
40
35
30
25
20
15
10
5
0
House wife
Health worker
Housemaid
Tailor
Teacher
Student
Farmer
Weaver
Clerk
Child
MALE(4.65%)
FEMALE(95.35%)


Age distribution in ornaments & metal objects exposure
30
25
20
15
10
5
0
6
24
22
16
18
<20
21-30
31-40
41-50
>50


Clinical patterns in ornaments & metallic objects exposure
2.40%
A
B
C
D
11.60%
Foot
19.80%
Hand
51.20%
Head, neck & shoulders
Extremities
15.10%


Patch test positivity in ornaments & metallic objects exposure
8
ALL 3
17
Cr
10
Ni + Co
2
Cr +Ni
17
Ni
27
Co
5
CHROMIUM
NICKEL
COBALT
Cr + Ni
Cr + Co
Ni + Co
ALL 3

METAL ANTIGENS

INDIAN STANDARD SERIES

ALLERGIC CONTACT DERMATITIS TO CEMENT - EXTREMITIES

ALLERGIC CONTACT DERMATITIS TO CEMENT- HANDS

ALLERGIC CONTACT DERMATITIS TO CEMENT-

LOWER LIMBS

PHOTOCONTACT DERMATITIS TO CEMENT

IRRITANT CONTACT DERMATITIS TO CEMENT

IRRITANT CONTACT DERMATITIS TO CEMENT

CONTACT DERMATITIS TO EAR RING (NICKEL)

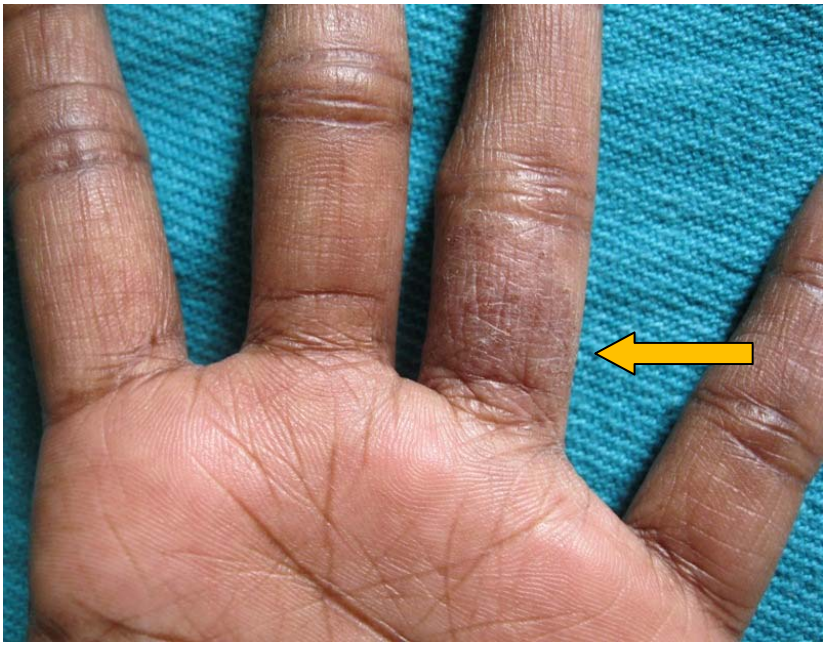
CONTACT DERMATITIS TO NECKCHAIN

CONTACT DERMATITIS TO SAFETY PIN

CONTACT DERMATITIS TO METAL CLIP

CONTACT DERMATITIS TO BANGLES

CONTACT DERMATITIS TO FINGER RING



POMPHOLYX IN NICKEL SENSITIVE PATIENT

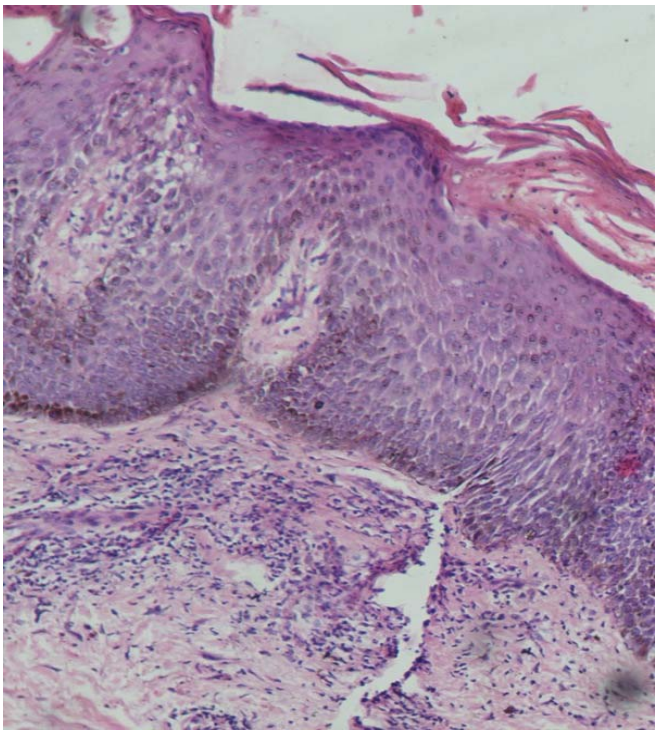
CONTACT DERMATITIS- SPECTACLE FRAME & SAFETY PIN

CONTACT DERMATITIS TO FOOTWEAR (LEATHER)

CONTACT DERMATITIS TO PAINT

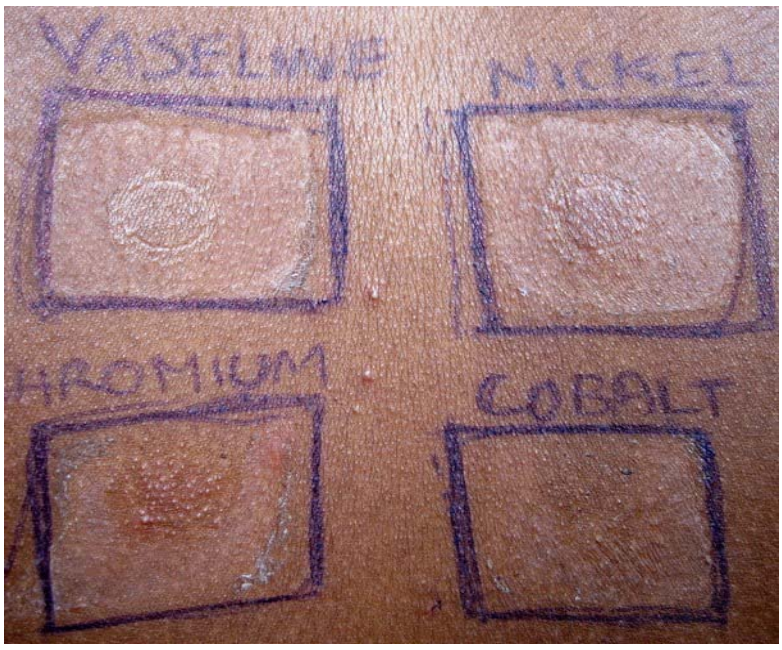
HISTOPATHOLOGY OF ALLERGIC CONTACT DERMATITIS

(FEATURES OF CHRONIC ECZEMA)

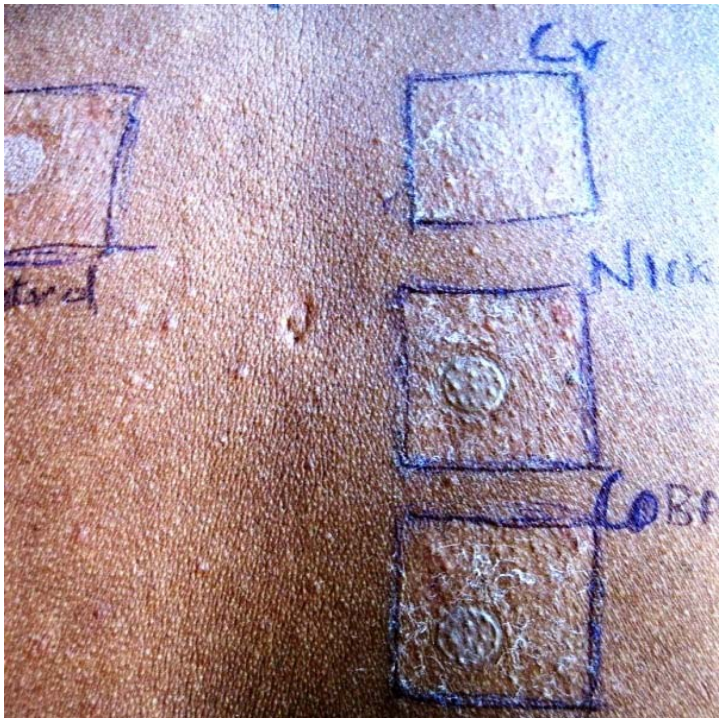


PATCH TESTING

PATCH TEST READING - 1+ (CHROMIUM)

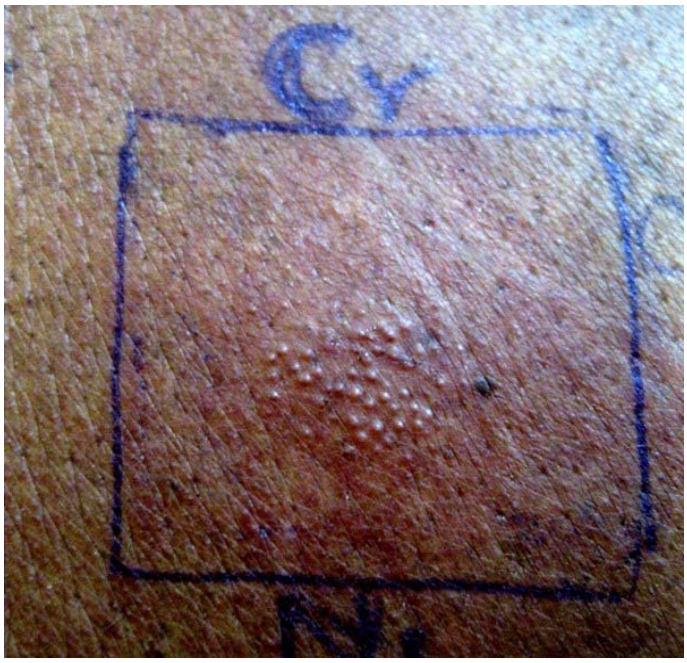


PATCH TEST READING – 1+ (Ni & Co)

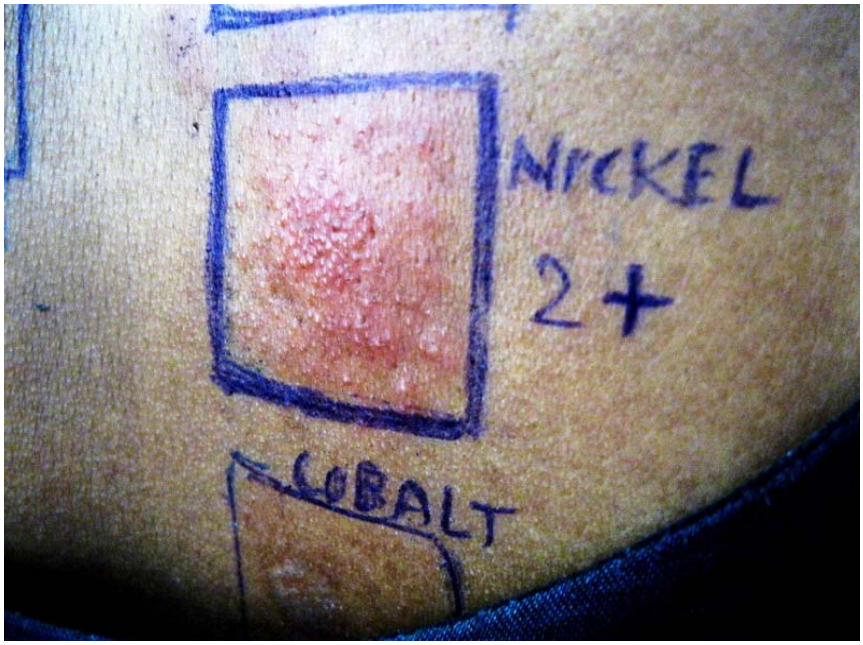


PATCH TEST READING – 1+ (CHROMIUM)

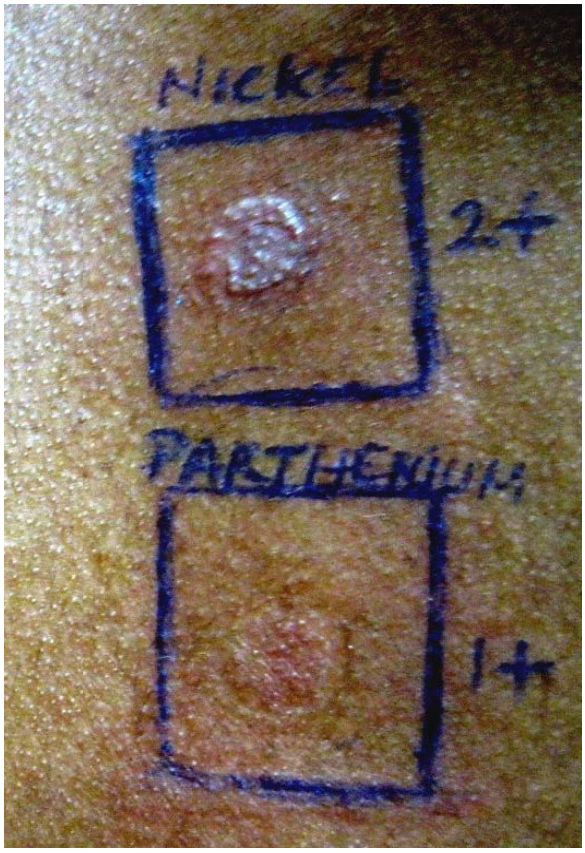
PATCH TEST READING – 2+ (CHROMIUM)



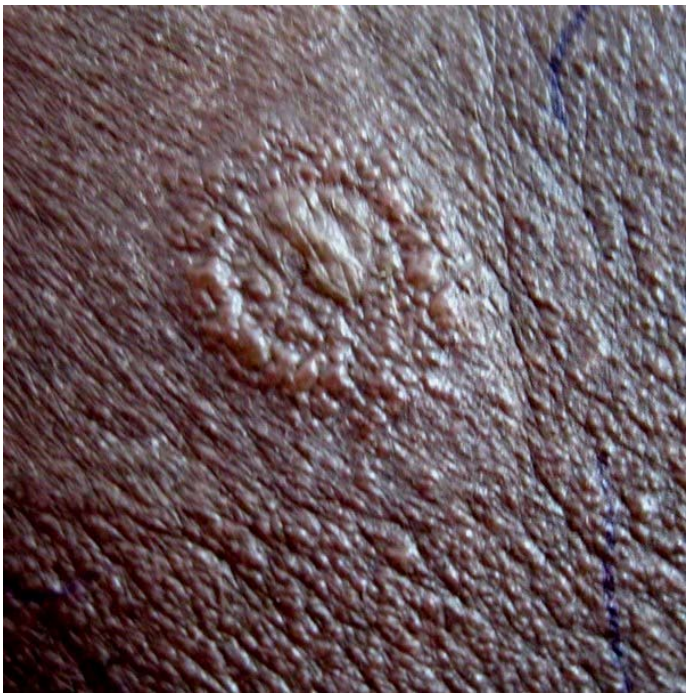
PATCH TEST READING - 2+ (NICKEL)



PATCH TEST READING TO Ni & PARTHENIUM



PATCH TEST READING 3+ (CHROMIUM)



IRRITANT REACTION TO CHROMIUM

Discussion

DISCUSSION

CLINICAL DIAGNOSIS OF METAL CONTACT DERMATITIS

Among the contact dermatitis to metals, allergic contact dermatitis to metals was the most common pattern seen in our study constituting 88.6%, followed by irritant contact dermatitis in 6.7% cases. Cement exposure was casuative in 54.4% cases.

In the cement exposure group, allergic and photoallergic contact dermatitis were the predominant patterns constituting 89% and irritant dermatitis was seen in 11%. M.Bock et al in his study on 'Contact dermatitis and allergy in the construction industry' has reported allergic contact dermatitis in 71.2% of the cement & construction workers and 75% in the tile setters and terrazzo workers.[101] Irvine et al in a study on cement dermatitis in underground channel tunnel construction workers, has also reported majority of the cases to be of allergic contact dermatitis.[102] Irritant contact dermatitis to cement was not detected in a Isfahan study on 'Cement contact dermatitis' by Fariba Iraji et al.[103]

DEMOGRAPHIC DATAS

Males were more than females in our study (1.21:1). In a study on 'Metal contact dermatitis'by Ida Duarte et al females formed the majority with a female to male ratio of 2.57:1.[104] This trend of increased

incidence among males in our study, may be due to more males being employed in the booming construction industry in our country.

There was no significant difference in the sensitization rates between males and females in our study as almost 95.45% (82 out of 86) of the ornaments & metallic objects exposure group were females and 84.5% (109 out of 129) of the cement exposure group were males. This nullified the effect of sex disparity in metal sensitivity.

Almost 75.6% (n=179) of the study group were in age group 21-50 years. Only one female child in the study was below the age of ten years and 5 were above the age of 60 years. This confirms the fact that contact allergies are less in the extremes of ages.

Occupationally cement exposure group formed 54.4% of the total and ornaments & metallic objects exposure group constituted 36.3%. Leather exposure, paint exposure and metal polish exposure formed the minority in the study. This trend may be due to the rapid industrialization and urbanisation leading to widespread constuction activities in and around the city. The male to female ratio in the cement exposure group was 5.4:1, while this ratio in the ornaments & metallic objects exposure group was 1:20.5. This may be due to the wide spread prevalence of ear piercing in female children in India and the wide availability of affordable ornamental jewellery in the Indian market. Due

to the socioeconomic factors, most women in India use ornamental jewels for cultural occasions leading to high nickel exposure in females.

ASSOCIATION WITH ATOPY

In our study, only 19.83% were atopics. Here, as in other studies atopy did not significantly influence the propensity for developing metal sensitivity. By Rui et al, personal and family history of atopy were not associated with metal sensitization in both men and women.[105] In a retrospective study done at Turkey on patch test results, there was no statistically significant difference in the total sensitization rate between atopics and nonatopics.[106] Chee Leok et al in a study on contact allergy in Singapore compared the data of 864 atopics with 2283 non atopics in occupational dermatitis. He concluded that the prevalence of contact allergy among atopics and non atopics was similar.[107]

CLINICAL PATTERNS

Dermatitis localized to the extremities was the most common clinical pattern in our study (30.8%). The next common pattern was dermatitis of the head, neck and the shoulders (18.98%). Hand eczema was third commonest (18.14%). This pattern was similar to a Taiwan study on 'Contact sensitization to metals' by Teh Yang Cheng et al, where the most common site of prediliction for the metal dermatitis was the extremities.[108] In contrast, in the study of 'Metal contact dermatitis'

by Ida Duarte et al, the most common locations were hands (37.5%), face (31%) and upperlimbs (30%).[104] The localization of the dermatitis to the extremities in our study was due to the exposure to cement in 55 patients (23.2%), and exposure to ornaments like bangles, wrist watches, anklets, etc in 13 patients (5.4%).

PATCH TEST RESULTS

In this study, chromium was the most common metal antigen to be patch test positive. Similarly in an Indian study by Sanjeev Handa et al on 'Patch test results from a contact dermatitis clinic in north India', the five most common allergens were potassium di chromate followed by nickel, fragrance mix, cobalt chloride and mercaptobenzothiazole.[108]

In males chromium sensitivity was seen in 95.38% (124) both as isolated sensitization and in association with other metals. In females, nickel was the most common metal antigen to be positive in 62.61% (67), followed by chromium in 56.1%. This predominance of sensitization with chromium in males and nickel in females was statistically significant (p value - <0.001). This association was due to the male predominance in the cement exposure group and the female predominance in the ornaments & metallic objects exposure group.

This gender distribution was similar to the study by Rui et al and Teh Yang Cheng et al.Teh Yang Cheng et al, reported that females were more likely to have contact sensitization to metals other than chromates.[109] According to his study, patients who reacted to chromates were more likely to be males, with an occupational correlation, older age and site of prediliction to the extremities. Though the prevalence of chrome sensitivity is decreasing in developed countries[110] it is still common in India as the construction industry is flourishing with more manual labourers. According to Rui et al, nickel was positively associated with metal and mechanical work and chrome sensitivity was more prevalent in buiding trade workers for both men and women.[105]

Positive reaction to cobalt was associated with chromium in 65.21%, with nickel in 47.82% and both nickel and chrome in 27.53%. Isolated sensitization to cobalt was seen in only 14.5%. This pattern was similar to the results of AK Bajaj et al where cobalt's concurrent positivity with chromium was 71%, with nickel in 41.8% and with both nickel and chrome in 23.6%.[95] Doom Goossens et al has reported that positive patch test reactions to cobalt are generally accompanied by allergic reactions to nickel or chromium.[99]

ISOLATED & ASSOCIATED SENSITIZATION OF METALS

In our study chromium was the most common metal to present as isolated sensitization and nickel & cobalt in association with other

metals. This sensitization pattern was statistically significant (p value-<0.001). In contrast, in a similar Brazil study on 'Metal contact dermatitis' by Ida Duarte et al nickel presented the highest sensitization prevalence in isolation, compared to chromium and cobalt.[104] But in both the studies, cobalt was the most common metal to present predominantly in asociation with chromium or nickel.

ANTIGENS ASSOCIATED WITH METALS

Parthenium was found to be most commonly associated with metals in 11 patients. Of the eleven, ten patients were from the cement exposure group. Among them 6 patients were working as both farmer and mason depending on the job availability. Four of them were working in construction sites that had parthenium in the surrounding. One female farmer tested positive to nickel, parthenium and PPD. Of the 11, 7 had airborn contact dermatitis with photosensitivity and 4 had only airborn contact dermatitis. This may be because of the wide spread distribution of the plant parthenium hysterophorus in Tamilnadu. In the study of 'common contact sensitizers in Chandigarh' by Sharma VK et al, he reported chrome positivity to be more common in Indian men (23.8%), followed by parthenium sensitivity (12.3%).[111] Hegewald et al in 'A multifactorial analysis of concurrent patch test reactions to metals' has reported, polysensitization to the standard series substances was significantly associated with concurrent reactions to metals.[2]

The sensitization of other antigens like balsum of Peru (9patients), turmeric (6), PPD (6), fragrance mix (2), colophony (2), formaldehyde (2) were more common in the ornaments & metallic objects exposure group, especially in females. This may be due to the simultaneous exposure of the Indian females to detergents and turmeric. In a Toronto study by Nethercott JR et al on 'cutaneous nickel sensitivity', patients with positive responses to nickel reacted to marginal irritants like formaldehyde and benzyl peroxide, suggesting a reduction in the irritancy threshold in nickel sensitive patients.[112]

CEMENT EXPOSURE

The mean age of cement workers in our study was 40.2 years as compared to 39years in the study on 'occupational skin disease in the construction industry' by M. Bock et al. This may be due to the long latency before the skin lesions appear. According to his study, male cement workers developed occupational skin diseases more frequently than females.[101] In our study the male to female cement workers was 5.45:1 as compared to 16.6:1 by M.Bock et al.

Among the cement exposed patients 65.9% developed contact dermatitis within 10 years, and the remaining 34.1%, after 10 years. In an Isfahan study on cement workers by Fariba Iraji et al, all the cement workers developed contact dermatitis within 10 years.[103] According to

M.Bock et al, construction and cement workers developed contact dermatitis after a median of 12 years in their occupation. This is the longest duration for any other occupational group in the BKH-N (register for occupatinal skin diseases) of Northern Bavaria.[101]

In the cement exposure group potassium di chromate was the most common sensitizer in 94.6% (122 of 129) of the total followed by cobalt in 27.13% (35 of 129). According to Wajdi Kanan et al in a study on cement workers of kuwait, all the 191 patients (100%) were sensitized to chromates while only 13(6.8%) of them reacted to cobalt.[113] In the study of Fariba Iraji et al, potassium di chromate caused roughly half of all cases of sensitization in the construction industry. M.Bock found 54.65% of the cement workers and 44.5% of the tile setters to be sensitized to potassium di chromate and he concluded that chrome was the most important allergen in the construction industry of Northern Bavaria.[101] Goh et al reviewed 6730 construction workers from Singapore during the period of 1981-87 and concluded that the source of chromium sensitivity can be traced to cement.[107]

In a study done at Singapore by Wong SS et al from 1990-95, they have concluded that chromium has become a less common occupational allergen because of the decline in the number of cases of allergic contact dermatitis from cement.[110] The EU directive 2003/53/EC requires the addition of ferrous sulfate to cement to reduce the level of

hexavalent chromium to trivalent chromium which has a lower degree of skin penetration. But in India potassium di chromate is still the commonest allergen. Among the cobalt positive patients of the cement exposure group, cobalt had concurrent positivity with chromium in 85.7% of the group. This pattern was similar to the study of M.Bock et al who found concomitant chromium sensitization in 97% of the cobalt positive cement workers.[101] Thus, cobalt is the most common source of cosensitization among chromate allergic subjects similar to the study of Olsavszky et al.[114]

ORNAMENTS & METALLIC OBJECTS EXPOSURE

Nickel exposure in India is common, as the use of ornamental jewellery is becoming more in vogue and there is no legal regulation for the nickel content in ornaments. Sharma AD, on ‘ Nickel nuisance: a clinical observation’ has reported that every third of the earring, every fourth of the bangles, all the safety pins and 64% of the wrist watches tested in his study, were positive for nickel by spot test. He has concluded that many of the jewellery and articles in the Indian market contain high nickel content leading to more nickel exposure.[28]

Females formed the majority of the ornaments & metallic objects exposure group (95.34%). Among them, housewives constituted 54.65% of the total. This may be due to the simultaneous exposure to the irritant chemical agents during wet and cleaning works making them more

sensitized to nickel. Most of the females gave history of itching at times of contact of ornamental jewels with sweat. According to Nethercott JR et al domestic rather than occupational exposure was thought to account for nickel allergy.[112] According to Fernanda Torres et al in 'The management of contact dermatitis due to nickel allergy', most cases are due to nonoccupational exposure and nickel allergy affected women 3 to 10 times more than men due to the daily contact with jewellery.[115]

In our study all the females had their ears pierced before the age of five years. Manu Shah in 'A survey on 368 nickel sensitive subjects' has reported that majority of the cases of nickel allergy are due to ear piercing and wearing of nickel plated jewellery.[116]

The youngest in the group was a female child of 18 months sensitized to nickel in the bangles and the pendant. J S Pasricha et al has also reported a 1 year old child developing contact dermatitis due to nickel in the bangles.[117] Among the total, 60.5% were below the age of 40 years. This may be due to high nickel exposure in the younger age groups. Duarte in a study on 'Contact dermatitis in adolescents' showed that in adolescents with a positive patch test reaction, 31% were allergic to nickel, making it the most common allergen in this age group.[118]

North American Contact Dermatitis group (NACDG) has reported that 16.2% of the U.S population test positive for nickel showing a rising trend. In another study of the Europian Surveillance System of

Contact Allergies to nickel highest prevalence was in Italy (32.2%) and the lowest in Denmark (9.7%).[119]

The most common clinical pattern among the ornaments & metallic objects exposed group in our study was localized dermatitis of the head, neck and shoulders (51.2%). This pattern was observed because majority of the patient in this group were senitized to chains, followed by ear rings and safety pins. This was similar to the study of Dawn G et al 'In the trends of nickel allergy in Scotland' where more number of patients presented with face and neck involvement.[120] In our study, hand eczema was seen in 19.8% of the group with dermatitis localized to the site of contact of rings, scissors and metal needles in weaving. Four patients of the hand eczema group had pompholyx. Patient with nickel sensitization to bangles, bracelets, wrist watches and anklets had contact dermatitis localized to the extremities (15.1%) forming the third common pattern in our study. Dermatitis localized to the foot was seen in 11.6% of the group. Among them, 6 patients were sensitized to detergents too. According to Nethercott JR et al, foot involvement in the nickel sensitive group was underrepresented.[112]

Nickel was the most common metal to be positive in 72% (62 patients) of the ornaments & metallic objects exposure group, followed by chromium in 51.16% (44 patients). Similarly, in an Indian study by AK Bajaj et al, nickel sensitivity was mostly accounted to the usage of ornamental jewellery.[95]

Conclusion

CONCLUSION

1. Allergic contact dermatitis to metal antigens was the commonest clinical pattern observed in 88.6 percent cases of the study.

2. Male to female ratio of the total cases was 1.21:1 with males predominating in the cement exposure group (ratio = 5.4:1) and females predominating in the ornaments & metallic objects exposure group (ratio = 1:20.5).

3. Most of the cases of metal contact dermatitis due to ornamental jewels were in the age group below 40 years, in comparision to older ages of 30-50 years in the cement exposed group.

4. Occupational exposure to metals was more common in the study with ratio of occupational to nonoccupational cases as 1.69:1.

5. Occupation wise, cement exposure was the commonest cause of metal contact dermatitis.

6. The mean duration of exposure to develop metal contact dermatitis in the occupational group was 4.7 years, with the cement exposure group having the longer latency of 5.2 years.

7. 19.8% of the study group was atopic. In our study, atopy did not significantly influence the propensity for developing metal sensitivity.

8. The commonest distribution of metal contact dermatitis was in the extremities in 30.8% of the total, followed by cement dermatitis in extremities in 42.6%. This emphasises the need for protective clothing, use of gloves and proper footwear to avoid occupational exposure and sensitization to metals.

9. The commonest distribution of dermatitis in ornaments & metal group was in the region of head, neck and shoulders in 51.2%. In our study the most common ornamental jewellery to cause nickel sensitization was neckchains, followed by earrings, safety pins and bangles.

10. Chromium was the commonest metal in the study to present as an isolated allergen in 46.8% of the total.

11. Cobalt sensitivity was predominantly associated with other metals in 24.9% of the study group.

12. Parthenium was the commonest allergen to be associated with metal sensitization, presenting as an airborne contact dermatitis or photodermatitis pattern. As this plant is wide spread and rampant, this has to be suspected in all cases of airborne contact and photocontactdermatitis.

13. Sensitivity to detergents, turmeric and PPD was more in the ornaments & metallic objects exposure group, especially in housewives and housemaids. This explains the leaching effect of wet works leading to more sensitization.

14. To conclude, chromium was the commonest metal allergen, in our study found positive in 77.6% of the total.

    - Chromium sensitivity was predominant in the groups occupationaly exposed to metal antigens, especially cement workers
    - Nickel sensitivity was predominant in the nonoccupationally exposed group, especially housewives.
    - Cobalt sensitivity was most commonly associated with concurrent sensitivity to chromium and nickel.

15. This study emphasises the need for standardization in the chrome content of cement and nickel content of ornamental jewels in the market.

16. Limitation of the study was that, spot test for nickel and chromium has not been done for ornaments and consumer articles. Patch test has not been done for other metals like silver as antigens were not available for them.

Annexures

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Proforma

PROFORMA

NAME :

AGE :

SEX :

OP.NO: :

OCCUPATION :

ADDRESS :

H/O PRESENT ILLNESS:

Onset

Progression

Exacerbating factors

Course of the disease

H/O ATOPY :

PAST HISTORY :

PERSONAL HISTORY :

TREATMENT HISTORY :

GENERAL EXAMINATIONS :

VITALS:

SYSTEMIC EXAMINATION:

CVS:

RS:

Abdomen:

DERMATOLOGICAL EXAMINATION:

Morphology:

Sites of involvement:

INVESTIGATIONS:

Hemogram: Hb

Total count

Differential count

ESR

Blood sugar:

Skin Biopsy:

Patch testing:

DIAGNOSIS :

TREATMENT :

ADVISE :

FOLLOW UP :

Master chart

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
1	M	4	Cement	6	P	ACD	Extremities	+	1+	neg	neg	
2	M	5	Cement	5	A	ACD	Extremities	+	2+	neg	neg	
3	M	4	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
4	M	5	Paint	5	A	ACD	Hand	+	1+	neg	1+	
5	F	4	Ornaments	Non occup	A	ICD	H,N,S	IR	IR	neg	neg	
6	M	2	Cement	2	A	ACD	Hand	+	1+	neg	neg	
7	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	1+	2+	neg	
8	M	2	Paint	3	A	ACD	Hand	+	neg	neg	1+	Epoxy resin
9	F	3	Ornaments	Non occup	P	ACD	Extremities	+	neg	2+	neg	
10	M	4	Metal polish	5	A	ACD	Extremities	+	2+	neg	neg	
11	M	4	Cement	2	A	ICD	Extremities	IR	IR	neg	neg	
12	M	4	Cement	4	A	ACD	Trunk	+	2+	neg	neg	
13	M	2	Cement	2	A	ACD	ABCD	+	2+	neg	neg	
14	F	4	Ornaments	5	A	ACD	Hand	+	neg	2+	neg	
15	M	5	Paint	4	P	ACD	Hand	+	1+	neg	neg	
16	M	3	Cement	2	A	ACD	Extremities	+	2+	neg	neg	
17	M	4	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
18	M	5	Cement	4	A	ICD	Extremities	IR	IR	neg	neg	
19	M	4	Cement	5	A	ACD	Trunk	+	1+	1+	neg	
20	F	3	Ornaments	Non occup	A	ACD	Extremities	+	1+	neg	neg	
21	M	3	Cement	1	A	ACD	ABCD	+	1+	2+	1+	Parthenium
22	M	3	Cement	3	A	ACD	Trunk	+	1+	2+	1+	
23	M	5	Cement	5	P	ACD	feet	+	2+	neg	1+	
24	F	4	Cement	2	A	ACD	ABCD	+	1+	neg	neg	
25	F	3	Ornaments	Non occup	A	ACD	feet	+	1+	3+	neg	
26	M	5	Cement	3	A	ACD	Extremities	+	2+	neg	neg	
27	M	1	Cement	3	A	ACD	Extremities	+	1+	neg	1+	
28	M	4	Leather	3	A	ACD	Trunk	+	1+	neg	neg	
29	M	2	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
30	M	3	Cement	2	A	ACD	Trunk	+	2+	neg	neg	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
31	M	2	Cement	3	A	ACD	feet	+	1+	neg	1+	
32	M	2	Cement	4	A	ACD	Extremities	+	3+	neg	neg	
33	M	2	Cement	2	A	ACD	Trunk	+	2+	neg	neg	
34	M	4	Cement	2	A	ACD	Extremities	+	1+	1+	1+	
35	M	5	Cement	4	A	ICD	Extremities	IR	IR	neg	neg	
36	M	2	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
37	M	5	Cement	6	A	ACD	Extremities	+	1+	neg	neg	
38	M	3	Cement	3	A	ACD	Extremities	+	2+	neg	neg	
39	M	4	Cement	5	A	ACD	Extremities	+	1+	neg	neg	
40	M	3	Cement	4	A	ACD	Extremities	+	3+	neg	neg	
41	F	3	Cement	1	A	ACD	feet	+	1+	neg	1+	Balsum
42	M	4	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
43	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	
44	F	2	Ornaments	3	A	ACD	Hand	+	neg	3+	neg	
45	F	2	Ornaments	3	A	ACD	Extremities	+	3+	1+	1+	Formaldehyde
46	F	4	Cement	2	A	ACD	ABCD	+	1+	neg	1+	Parthenium
47	M	3	Cement	3	A	ACD	feet	+	2+	neg	neg	
48	F	5	Cement	1	P	ACD	feet	+	2+	neg	neg	Balsum
49	F	2	Ornaments	Non occup	A	ACD	feet	+	1+	1+	1+	Formaldehyde
50	M	2	Cement	3	A	ACD	Hand	+	2+	neg	neg	
51	M	4	Cement	3	P	ACD	Trunk	+	2+	neg	neg	
52	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	1+	neg	neg	PPD
53	F	5	Ornaments	Non occup	A	ACD	Extremities	+	1+	neg	neg	Colophony
54	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	2+	neg	neg	PPD
55	F	1	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	neg	
56	M	5	Cement	3	P	ACD	feet	+	2+	neg	neg	
57	M	3	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
58	M	2	Cement	3	P	ACD	feet	+	1+	neg	neg	
59	M	3	Cement	3	P	PCD	ABCD+ P	+	3+	neg	neg	
60	M	2	Cement	4	A	ACD	feet	+	2+	neg	neg	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
61	F	5	Cement	5	A	ACD	Hand	+	1+	neg	neg	
62	F	2	Ornaments	Non occup	A	ACD	Extremities	+	1+	neg	neg	
63	F	5	Ornaments	Non occup	P	ACD	H,N,S	+	neg	3+	1+	
64	F	5	Cement	6	A	ACD	Extremities	+	1+	1+	1+	Parthenium
65	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	Turmeric
66	M	2	Paint	2	A	ACD	Extremities	+	2+	neg	neg	
67	M	5	Ornaments	5	P	ACD	Hand	+	3+	1+	1+	
68	F	2	Ornaments	Non occup	A	ACD	Extremities	+	neg	1+	neg	
69	F	3	Cement	1	A	ACD	Trunk	+	1+	neg	neg	
70	M	5	Cement	4	A	ACD	feet	+	1+	neg	1+	
71	M	2	Cement	1	A	ICD	Extremities	IR	IR	neg	neg	
72	M	3	Paint	1	P	ACD	Hand	+	2+	neg	neg	
73	M	2	Cement	3	A	ACD	Extremities	+	neg	neg	1+	
74	M	5	Cement	1	P	ACD	Extremities	+	1+	neg	neg	
75	M	4	Cement	4	P	ACD	Trunk	+	1+	1+	1+	
76	M	4	Cement	2	P	ACD	Extremities	+	2+	neg	neg	
77	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	
78	M	2	Cement	1	A	ACD	Extremities	+	1+	neg	neg	
79	M	2	Cement	2	A	ICD	feet	IR	IR	neg	neg	
80	M	2	Cement	3	A	ACD	Extremities	+	1+	neg	1+	
81	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	1+	2+	neg	
82	M	4	Cement	3	A	ACD	feet	+	3+	1+	1+	
83	M	2	Leather	1	A	ACD	Hand	+	1+	neg	neg	
84	M	2	Cement	2	A	ACD	Trunk	+	1+	neg	neg	
85	M	5	Cement	3	A	ICD	Hand	IR	IR	neg	neg	
86	M	2	Cement	2	A	ICD	Extremities	IR	IR	neg	neg	
87	M	4	Ornaments	Non occup	A	ACD	H,N,S	+	1+	2+	1+	
88	F	1	Ornaments	Non occup	A	ACD	Hand	+	2+	1+	neg	
89	F	4	Ornaments	Non occup	P	ACD	H,N,S	+	1+	3+	neg	Colophony
90	M	4	Cement	6	A	ICD	Extremities	IR	IR	neg	neg	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
91	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	1+	2+	neg	
92	F	3	Cement	2	A	ACD	Extremities	+	neg	neg	1+	
93	F	2	Ornaments	Non occup	A	ACD	Hand	+	neg	1+	1+	
94	F	3	Ornaments	2	A	ACD	Extremities	+	1+	2+	neg	
95	F	4	Ornaments	Non occup	A	ACD	Hand	+	1+	2+	neg	
96	M	5	Cement	2	A	ACD	Trunk	+	1+	neg	neg	
97	M	2	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
98	F	4	Cement	5	A	PCD	ABCD+ P	+	neg	1+	1+	
99	M	3	Cement	2	A	ACD	Trunk	+	1+	neg	2+	
100	M	4	Cement	1	A	ACD	Extremities	+	1+	neg	neg	
101	M	5	Cement	2	A	ICD	Hand	IR	IR	neg	neg	
102	M	3	Cement	3	A	ACD	Hand	+	1+	neg	1+	
103	M	2	Cement	3	A	ACD	Extremities	+	1+	2+	neg	
104	M	4	Cement	2	A	ACD	feet	+	2+	neg	2+	
105	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	
106	M	4	Cement	2	A	ACD	Extremities	+	2+	neg	1+	
107	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	neg	
108	M	4	Cement	3	A	ACD	feet	+	1+	neg	1+	
109	M	5	Cement	5	A	ICD	Hand	IR	IR	neg	neg	
110	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	neg	Balsum
111	M	5	Others	6	A	ACD	Hand	+	2+	neg	neg	
112	M	4	Cement	4	A	ACD	Extremities	+	2+	1+	neg	
113	F	2	Ornaments	Non occup	P	ACD	Extremities	+	neg	1+	1+	Balsum
114	F	2	Ornaments	3	P	ACD	Hand	+	neg	2+	1+	
115	F	3	Ornaments	Non occup	P	ACD	H,N,S	+	2+	neg	neg	Turmeric
116	M	3	Cement	4	A	ACD	Trunk	+	1+	1+	neg	
117	F	2	Ornaments	Non occup	A	ACD	feet	+	neg	1+	neg	Fragrance
118	M	3	Cement	4	A	ACD	Extremities	+	1+	neg	neg	
119	M	5	Cement	3	A	ICD	Extremities	IR	IR	neg	neg	
120	M	3	Cement	3	A	ACD	feet	+	1+	1+	neg	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
121	M	3	Cement	2	A	ACD	feet	+	1+	neg	1+	
122	M	2	Paint	3	A	ACD	Extremities	+	1+	1+	neg	
123	M	2	Cement	3	A	ACD	Trunk	+	2+	neg	neg	
124	F	2	Ornaments	Non occup	A	ACD	feet	+	1+	1+	1+	Balsum
125	F	4	Cement	2	A	ACD	Hand	+	neg	1+	1+	
126	M	2	Cement	3	P	ACD	feet	+	2+	neg	neg	
127	M	4	Cement	4	A	ACD	feet	+	1+	neg	neg	
128	F	4	Cement	1	A	PCD	ABCD+ P	+	1+	neg	neg	Parthenium
129	F	2	Ornaments	Non occup	A	ACD	Hand	+	neg	2+	neg	
130	F	3	Ornaments	Non occup	P	ACD	ABCD	+	1+	1+	1+	Parthenium + PPD
131	M	4	Cement	2	A	ACD	feet	+	2+	neg	1+	
132	F	5	Ornaments	Non occup	A	ICD	H,N,S	IR	neg	IR	neg	
133	M	2	Cement	2	A	ACD	Hand	+	1+	1+	1+	
134	M	3	Cement	4	A	ACD	Extremities	+	1+	neg	neg	
135	F	4	Cement	2	A	ACD	ABCD	+	1+	neg	neg	
136	M	2	Leather	2	P	ACD	Trunk	+	1+	neg	neg	
137	M	3	Cement	4	A	ICD	feet	IR	IR	neg	neg	
138	M	3	Cement	1	A	ACD	ABCD	+	1+	neg	neg	Parthenium
139	M	3	Cement	2	A	ACD	Extremities	+	2+	neg	neg	
140	M	5	Ornaments	5	P	ACD	Hand	+	1+	neg	neg	
141	M	3	Cement	2	A	ACD	Extremities	+	1+	1+	neg	
142	F	2	Ornaments	Non occup	P	ACD	H,N,S	+	neg	neg	1+	
143	M	5	Cement	5	P	PCD	ABCD+ P	+	2+	neg	neg	Parthenium
144	F	5	Ornaments	Non occup	P	ACD	H,N,S	+	1+	1+	neg	
145	M	3	Cement	4	A	ACD	Hand	+	neg	1+	1+	
146	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	
147	F	4	Ornaments	Non occup	A	ACD	Hand	+	neg	1+	1+	
148	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	1+	neg	neg	PPD
149	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	2+	neg	neg	
150	F	4	Ornaments	Non occup	A	ACD	Hand	+	neg	1+	1+	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
151	M	3	Cement	2	P	ACD	Extremities	+	neg	2+	neg	
152	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	1+	1+	neg	Balsum
153	M	3	Cement	4	A	ACD	Trunk	+	1+	neg	neg	
154	M	4	Cement	2	P	ACD	ABCD	+	2+	neg	neg	
155	F	1	Ornaments	Non occup	A	ACD	feet	+	neg	2+	neg	Fragrance
156	F	3	Ornaments	Non occup	A	ACD	Extremities	+	neg	1+	neg	Turmeric
157	F	2	Ornaments	Non occup	A	ACD	Hand	+	neg	2+	neg	Balsum
158	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	1+	
159	M	3	Cement	4	A	ACD	Extremities	+	1+	neg	neg	
160	F	3	Ornaments	Non occup	P	ACD	feet	+	1+	neg	neg	
161	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	neg	
162	M	1	Cement	2	A	ACD	Hand	+	2+	neg	neg	
163	F	4	Cement	3	A	ACD	Hand	+	1+	neg	1+	
164	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	neg	neg	1+	PPD
165	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	neg	1+	neg	
166	F	3	Leather	4	A	ACD	Hand	+	neg	2+	1+	
167	F	2	Ornaments	Non occup	P	ACD	H,N,S	+	neg	2+	neg	Turmeric
168	M	3	Cement	2	A	ACD	feet	+	1+	neg	neg	
169	F	4	Ornaments	Non occup	A	ACD	Hand	+	neg	2+	2+	
170	M	4	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
171	F	3	Ornaments	2	A	ACD	Hand	+	1+	neg	neg	Balsum
172	F	3	Ornaments	Non occup	A	ACD	Extremities	+	1+	1+	neg	
173	M	4	Cement	4	P	ACD	Extremities	+	2+	neg	neg	
174	M	3	Cement	2	A	ACD	Trunk	+	1+	neg	2+	
175	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	2+	neg	neg	Turmeric
176	M	2	Cement	2	A	ACD	Hand	+	1+	neg	1+	
177	F	2	Leather	Non occup	A	ACD	feet	+	2+	neg	neg	Formaldehyde
178	F	3	Metal polish	1	A	ACD	H,N,S	+	2+	neg	neg	
179	F	2	Ornaments	Non occup	A	ACD	feet	+	neg	1+	neg	Balsum
180	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	neg	neg	1+	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
181	F	2	Ornaments	Non occup	P	ACD	H,N,S	+	neg	2+	neg	
182	F	4	Cement	2	A	PCD	ABCD+ P	+	2+	neg	neg	Parthenium
183	F	2	Cement	4	A	ACD	Trunk	+	1+	neg	neg	
184	M	5	Cement	6	A	ACD	ABCD	+	1+	neg	1+	
185	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	1+	neg	neg	
186	F	3	Ornaments	Non occup	A	ACD	feet	+	neg	neg	1+	
187	M	3	Cement	2	A	ACD	Extremities	+	1+	neg	neg	
188	M	3	Cement	3	A	ACD	Trunk	+	3+	neg	neg	
189	M	3	Ornaments	4	A	ACD	Hand	+	1+	neg	1+	
190	F	3	Ornaments	Non occup	A	ACD	Extremities	+	1+	1+	1+	PPD
191	M	3	Cement	2	P	ACD	Extremities	+	1+	1+	neg	
192	F	4	Paint	2	A	ACD	Hand	+	1+	neg	1+	
193	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	1+	1+	neg	
194	M	5	Cement	4	A	ACD	Extremities	+	1+	neg	neg	
195	M	2	Cement	3	P	PCD	ABCD+ P	+	1+	1+	neg	
196	M	2	Metal polish	4	A	ACD	Hand	+	neg	neg	1+	
197	F	5	Cement	6	A	PCD	ABCD+ P	+	1+	1+	neg	Parthenium
198	F	3	Cement	4	A	PCD	ABCD+ P	+	1+	2+	1+	Parthenium
199	F	2	Ornaments	Non occup	P	ACD	H,N,S	+	neg	1+	neg	
200	M	5	Cement	6	P	ACD	Hand	+	2+	1+	1+	
201	F	4	Ornaments	Non occup	P	ACD	H,N,S	+	neg	1+	neg	
202	F	1	Leather	1	A	ACD	Extremities	+	neg	neg	1+	
203	F	5	Ornaments	Non occup	A	ACD	Extremities	+	neg	1+	1+	Turmeric
204	F	3	Ornaments	Non occup	A	ACD	H,N,S	+	1+	1+	1+	
205	M	3	Paint	5	A	ACD	Hand	+	1+	neg	1+	Epoxy + For
206	M	3	Leather	4	A	ACD	Extremities	+	1+	neg	neg	Formaldehyde
207	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	1+	neg	neg	
208	F	5	Ornaments	Non occup	A	ACD	Hand	+	neg	1+	neg	
209	M	1	Cement	2	A	PCD	ABCD+ P	+	1+	neg	neg	
210	M	2	Cement	4	A	ACD	Extremities	+	1+	neg	neg	

slno	Sex	Age	Occupation	Occup duration	Atopy	Clinical diagnosis	Pattern	Patch test	Cr	Ni	Co	Association
211	F	5	Ornaments	Non occup	A	ACD	Hand	+	1+	neg	neg	
212	F	1	Ornaments	Non occup	A	ACD	H,N,S	+	neg	neg	1+	
213	F	3	Cement	1	A	ACD	Extremities	+	1+	neg	neg	
214	F	1	Ornaments	Non occup	A	ACD	feet	+	1+	1+	neg	
215	M	5	Cement	6	P	ICD	Extremities	IR	IR	neg	neg	
216	F	1	Ornaments	Non occup	P	ACD	Extremities	+	neg	1+	1+	
217	M	5	Cement	6	P	ACD	Hand	+	1+	neg	1+	
218	M	2	Metal polish	3	P	ACD	feet	+	1+	1+	1+	
219	F	2	Ornaments	Non occup	A	ACD	H,N,S	+	1+	2+	neg	
220	F	4	Ornaments	Non occup	A	ACD	H,N,S	+	1+	1+	neg	PPD
221	M	4	Others	2	A	ACD	Hand	+	2+	neg	neg	Formaldehyde
222	M	4	Cement	4	A	ACD	Extremities	+	1+	neg	neg	
223	F	2	Cement	1	A	ACD	Trunk	+	1+	2+	neg	
224	M	5	Cement	6	A	PCD	ABCD+ P	+	neg	1+	neg	Parthenium
225	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	1+	neg	neg	
226	F	2	Ornaments	Non occup	P	ACD	feet	+	1+	1+	neg	
227	M	4	Cement	3	P	PCD	ABCD+ P	+	3+	neg	neg	Parthenium
228	F	5	Ornaments	Non occup	A	ACD	H,N,S	+	neg	2+	neg	
229	M	3	Cement	2	A	ACD	Trunk	+	1+	neg	neg	
230	M	4	Cement	6	P	ACD	Trunk	+	1+	neg	neg	
231	F	5	Ornaments	Non occup	A	ACD	Extremities	+	1+	neg	1+	
232	M	4	Cement	3	P	ACD	Extremities	+	2+	1+	1+	
233	F	3	Cement	5	P	ACD	Extremities	+	1+	neg	1+	
234	M	5	Cement	3	A	ICD	Extremities	IR	IR	neg	neg	
235	M	4	Cement	5	A	ACD	Extremities	+	1+	neg	neg	
236	M	5	Leather	Non occup	A	ACD	feet	+	1+	neg	1+	
237	F	3	Ornaments	Non occup	P	ACD	H,N,S	+	1+	2+	neg	

KEY TO MASTER CHART

SEX : M – male

F – female

AGE: 1=< 20 years

2=21-30years

3=31-40years

4=41-50years

5= > 50years

Occupation duration 1= < 1year

2= 1-5 years

3= 5-10 years

4= 10-20 years

5= 20-30 years

6= >30 years

Atopy: P= present

A= absent

Diagnosis: ACD= allergic contact dermatitis

ICD= irritant contact dermatitis

PCD= photo allergic contact dermatitis

Clinical pattern: H,N,S= Localized to Head, neck & shoulder

Extremities=Localized to extremities(UL, LL or both)

Hand= Localized to hand only

Foot= Localized to foot only

Trunk= Localized to trunk, back & extremities.

ABCD= ABCD with photosensitivity

ABCD + P= Air borne contact dermatitis (ABCD)

Grading: IR= irritant reaction

Abbreviations

ABBREVIATIONS

ACD	**:**	Allergic contact dermatitis
ICD	**:**	Irritant contact dermatitis
ICAM	**:**	Intercellular adhesion molecule
IL-1	**:**	Interleukin 1
TNFα	**:**	Tumor necrosis factor α
IL-1β	**:**	Interleukin 1 β
GM CSF	**:**	Granulocyte monocyte colony stimulating factor
CLA	**:**	Cutaneous lynphocyte antigen
Cr	**:**	Chromium
Ni	**:**	Nickel
Co	**:**	Cobalt